WORK PLAN

FOR WATERSHED PROTECTION, FLOOD PREVENTION, and AGRICULTURAL WATER MANAGEMENT

JORDAN CREEK WATERSHED

Warren County, Indiana

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

OUR SOIL ★ OUR STRENGTH

USDA-SCS-LINCOLN, NEBR. 1970

#234,272

ADDENDUM

to the

JORDAN CREEK WATERSHED WORK PLAN

Warren County, Indiana

This addendum is in response to the established Principles and Standards of the Water Resources Council and has been developed in accordance with the USDA Procedures for Planning Water and Related Land Resources.

Information included consists of:

I. Evaluation of Plan with Current Installation Costs and Discount Rate

II. Abbreviated Environmental Quality Plan

III. Selected Plan - Display Tables

JORDAN CREEK WATERSHED

I. EVALUATION OF PLAN WITH CURRENT INSTALLATION COST AND DISCOUNT RATE

This addendum shows project cost based on 1974 price base for construction costs amortized for 100 years at 6 1/8 percent interest.

Benefits for this addendum are based on current normalized prices for agricultural commodities and current prices (1974) for other items.

Annual project benefits, costs and benefits--cost ratio are as follows:

Total benefits	$496,060
Total costs	124,800
Benefit--cost ratio	4.0:1.0

Annual project benefits (less secondary benefits), costs and benefits--cost ratio are as follows:

Total benefits (less secondary)	$288,840
Total costs	124,800
Benefit--cost ratio	2.3:1.0

II. ABBREVIATED ENVIRONMENTAL QUALITY PLAN

ENVIRONMENTAL PROBLEMS

Areas of natural beauty

The watershed has a limited variety of scenery because of land use patterns, topography, lack of lakes, perennial streams, major water courses and other natural features. About 94.5 percent of the area is devoted to agricultural uses with 5.5 percent in wildlife, recreation, and forest land.

The lower reaches of Jordan Creek are fairly well entrenched, are wooded, and have some rock riffles. This area is small and is included in the previously mentioned 5.5 percent.

Water and land quality

Erosion in terms of sediment production is slightly above tolerable limits on 8,400 acres of cropland or 24 percent of the watershed. The average soil loss in this area is estimated at 5.7 tons/acre/year, which is above the tolerable limit of 3.5.

Sediment yield from the watershed is low; about 0.33 tons/acre/year. However, high intensity, short duration storms on fallow field conditions will periodically discharge sediment and associated pollutants into Jordan Creek.

Biological resources and selected ecosystems

The predominant agricultural monoculture provides a small amount of unvaried wildlife habitat. Clean-tillage practices destroy suitable habitat for wildlife species that favor upland agriculture. The watershed is short of surface water habitat for fish and wildlife.

COMPONENT NEEDS

1. Improve water and land quality by controlling erosion, sedimentation, and other pollutants.

2. Establish, improve, and manage fish and wildlife habitat.

3. Provide diversity of landscape.

PLAN ELEMENTS

1. Install appropriate land treatment measures on about 27,517 acres. Included are contour farming, grassed waterways or outlets, minimum tillage, crop residue use, grade stabilization structures and other measures as needed. Soil conserving mechanical practices and cropping systems would be applied on all cropland. Pasture would be used and managed to protect stand cover and maintain vigor of desired plant species. The estimated cost of installation, including technical assistance, is $754,280.

2. Implement proper land use within capability. Convert 8,400 acres of cropland presently exceeding tolerable soil loss to pasture or forest land. The estimated installation cost, including technical assistance, is $705,600.

3. Eliminate feedlot discharge into streams and ground water aquifers. Install 3 holding ponds for livestock feedlot runoff at a cost of $6,000.

4. Convert about 2,520 acres of cropland into parcels of forest land. These parcels should be 10 acres or larger and should be scattered throughout the watershed on soils suited for trees involved. The estimated installation cost of this conversion, including technical assistance and cost of land, is $4,069,800.

5. Establish about 1,170 acres of upland wildlife areas in scattered blocks such as in "off field" areas and along fence rows and ditchbanks. The vegetation should be a mixture of trees, shrubs, and herbaceous plants which have a high value for wildlife food and/or cover. The estimated establishment cost, including technical assistance and cost of land, is $1,858,000.

6. Convert about 1,125 acres of cropland to wetland. A large, single block of wetland is more desirable than scattered wetland areas. The estimated cost of conversion, including technical assistance and cost of land, is $1,260,900.

7. Restrict land use for a distance of 50 feet from each edge of the stream or ditchbanks. The acreage involved could be considered as part of the 1,170 acres of the upland wildlife area previously mentioned. The estimated installation cost, including technical assistance, is $71,350.

INSTITUTIONAL ARRANGEMENT

Institutional arrangements available and needed for the implementation of the Environmental Quality Plan. Legal entities of government are in existence for the implementation of the EQ Plan. They include township and county governments and the Soil and Water Conservation District. Township and county governments have the power of eminent domain and taxation by law.

State and federal programs are available, providing financial assistance both for land acquisition and for establishment of measures to implement the EQ Plan, namely:

State Programs

Indiana Department of Natural Resources

a. Forestation Program - Provide tree planting stocks and technical assistance;

b. Private Land Wildlife Habitat Improvement Program - provide technical assistance to create wildlife habitat on private lands; and

c. Natural Resource Funds - provide financial assistance for developing fish and wildlife habitat.

Federal Programs

1. U.S. Department of Agriculture

   a. Resource Conservation and Development - Financial and technical assistance involving human and natural resources;

   b. Agricultural Conservation Program - provides cost sharing assistance to individual landowners for application of conservation practices; and

   c. Loans and Advances - provide loans and advances to sponsoring organizations.

2. U.S. Department of Interior

   a. Pitman-Robertson Funds - Provide for wildlife research and financial and technical assistance in developing wildlife habitat areas. Administered by the state.

INSTITUTIONAL ARRANGEMENT - CONT'D

b. Dingell-Johnson Funds - Provide for fishery research and financial and technical assistance in developing fishery habitat areas. Administered by the state.

Technical assistance including educational and on-site assistance is available from:

1. Warren County Soil and Water Conservation District
2. Cooperative Extension Service
3. Indiana Department of Natural Resources
4. USDA including Soil Conservation Service and Forest Service
5. USDI, U.S. Fish and Wildlife Service

EFFECTS

Water and land quality

The installation of the land treatment measures will reduce the average annual soil loss on 8,400 acres of cropland from 5.7 tons/acre/year to the tolerable limit of 3.5 tons/acre/year. The measures will reduce erosion and sedimentation by 42 percent and decrease the watershed's contribution of sediment to Jordan Creek from 12,000 tons/year to 9,000 tons/year. This reduction will reduce agricultural pollutants that are borne by sediment.

Implementation of land use compatible with the capability of the soils can reduce erosion and sedimentation in the same manner as land treatment. Therefore, the effects on water and land quality would be similar.

Biological resources and selected ecosystems

The installation of the forest land, upland wildlife habitat, wetlands, the 50-foot strip each side of the stream, and the 1.5 miles of stream improvement will increase desirable habitat for fish and wildlife considerably over the existing conditions.

The nature of the habitat (upland, wetland, forest land) will be compatible with many species of plants and animals that are now scarce or nonexistent in the watershed.

The amount of land required for land use conversion, for improved environmental stability, and for wildlife habitat purposes is approximately 4,815 acres or about 13 percent of the watershed area.

EFFECTS - CONT'D

The population of bobwhite quail and other game species such as cottontail rabbit, ringneck pheasant and squirrel would be improved by an estimated 400 percent. Non-game wildlife species such as songbirds and small mammals would be increased by an estimated 500 percent.

JORDAN CREEK WATERSHED

SYSTEM OF ACCOUNTS DISPLAY

The following tables illustrate a display of beneficial and adverse effects of the selected plan for Jordan Creek Watershed in the National Economic Development, Regional Development, Social Well-Being and Environmental Quality Accounts.

III. SELECTED PLAN - NATIONAL ECONOMIC DEVELOPMENT ACCOUNT: The following table reflects increases in the Nation's productive output.

Dollars

Components	Measures of Effects Average Annual	Components	Measures of Effects Average Annual
Beneficial Effects		Adverse Effects	
A. The value to users of increased outputs of goods and services.		A. The value of resources required for a plan.	
1. Flood prevention	$150,340	1. Channel work, surface drains, grassed waterways and tile	
2. Drainage	138,500	Project installation 1/	$89,210
		Project administration 1/	15,360
		OM&R	15,850
TOTAL BENEFICIAL EFFECTS	288,840	TOTAL ADVERSE EFFECTS	$120,420
		NET BENEFICIAL EFFECTS	$168,428

1/ Amortized at 5 7/8 percent interest for 100 years.

JORDAN CREEK WATERSHED

III. SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT: The following table reflects increases in the region's productive output.

Dollars

Components	Measures of Effects Average Annual State of Ind.	Rest of Nation	Components	Measures of Effects Average Annual State of Ind.	Rest Nation
Income Beneficial Effects			Income Adverse Effects		
A. The value of increased output of goods and services to users residing in the region.			A. The value of resources contributed from within the region to achieve the outputs.		
1. Flood prevention	$150,340	--	1. Channel work, surface drains, grassed waterways and tile		
2. Drainage	138,500	--	Project installation 1/	$34,050	$55,160
			Project administation 1/	2,000	13,360
			OM&R	15,850	
TOTAL BENEFICIAL EFFECTS	$288,840		TOTAL ADVERSE EFFECTS	51,900	68,520
			NET BENEFICIAL EFFECTS	$236,940	-$68,520

1/ Amortized at 5 7/8 percent interest for 100 years.

III. SELECTED PLAN - REGIONAL DEVELOPMENT ACCOUNT

COMPONENTS	MEASURES OF EFFECTS	REST OF NATION
B. Employment	1. During the period of construction approximately 39 man-years of labor will be required for the installation.	--
	2. During the life of the project, about 8 man-years will be required annually for the operation and maintenance for structural and associated land treatment measures.	--
C. Regional Economic Base & Stability	The average net income increase will be approximately $3,280 annually.	

III. SELECTED PLAN - SOCIAL WELL-BEING ACCOUNT: The following table reflects effects on society.

COMPONENTS	MEASURES OF EFFECTS
Real income distribution	1. Create regional income benefit distribution of $496,060 by income class as follows:

Income Class ($)	Adjusted Gross Income in Class (%)	Benefits in Class (%)
Less than $5,000	34	10
$5,000 to $10,000	15	55
More than $10,000	51	35

2. Local costs to be borne annually by region total $51,900 with distribution by income class as follows:

Income Class ($)	Adjusted Gross Income in Class (%)	Continuation in Class (%)
Less than $5,000	34	10
$5,000 to $10,000	15	55
More than $10,000	51	35

III. SELECTED PLAN - ENVIRONMENTAL QUALITY ACCOUNT: The following table reflects effects on the natural physical-biological system.

COMPONENTS

Beneficial and Adverse Effects:

A. Areas of natural beauty

1. Destroy 22 acres of woody wildlife habitat during construction.
2. Plant 27 acres of trees and shrubs.
3. Protect existing woody material within the permanent easement.
4. Establish a maintenance program for channels and streambanks.
5. Manage 15 acres of forest land.

B. Quality considerations of water, land, and air resources

1. Increase noise, air, and water pollution for a short term during construction.
2. Reduce erosion on 8,400 acres of cropland, grassland, and forest land.

C. Biological resources and selected ecosystems

1. Destroy 22 acres of woody wildlife habitat during construction.
2. Plant 27 acres of trees and shrubs.
3. Protect existing woody material within the permanent easement.
4. Plant 56 acres of streambank to grass.
5. Manage 15 acres of forest land.

D. Irreversible and Irretrievable

Sixty-nine acres of cropland converted to wildlife habitat. Land usage within the project permanent easement area before and after project follows:

D. Irreversible and Irretrievable - cont'd

Land Use	Present	Future
Cropland	69 ac.	-- ac.
Forest land	13 ac.	15 ac.
Grassland	43 ac.	73 ac.
Other land 1/	69 ac.	106 ac.

These conversions are considered to be committed for the project life.

1/ Other land includes channel bottom and side slopes and areas providing wildlife habitat adjacent to the channel.

WATERSHED WORK PLAN

JORDAN CREEK WATERSHED

Warren County, Indiana

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as Amended

Prepared by:

Warren County Soil and Water Conservation District
Jordan Creek Conservancy District
State of Indiana

Technical Assistance By:

U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of Agriculture, Forest Service
U.S. Department of Interior, Fish and Wildlife Service
Indiana Department of Natural Resources

October 1975

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WATERSHED WORK PLAN AGREEMENT

between the

Warren County Soil and Water Conservation District

and the

Jordan Creek Conservancy District

of the

State of Indiana

(hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Jordan Creek Watershed, State of Indiana, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Jordan Creek Watershed, State of Indiana, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing consideration, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about eight (8) years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire, with other than PL-566 funds, such land rights as will be needed in connection with the works of improvement. (Estimated cost - $267,000) The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Jordan Creek Conservancy District (%)	Service (%)	Estimated Land Rights Cost ($)
All Structural Measures	100	0	267,000

2. The Sponsoring Local Organization assures that comparable replacement dwellings will be available for individuals and persons displaced from dwellings, and will provide relocation assistance advisory services and relocation assistance, make the relocation payments to displaced persons, and otherwise comply with the real property acquisition policies contained in the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (Public Law 91-646, 84 Stat. 1894) effective as of January 2, 1971, and the Regulations issued by the Secretary of Agriculture pursuant thereto. The costs of relocation payments will be shared by the Sponsoring Local Organization and the Service as follows:

	Jordan Creek Conservancy District (%)	Service (%)	Estimated Relocation Payment Costs ($)1/
Relocation Payments	53	47	0

3. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to state law as may be needed in the installation and operation of the works of improvement.

1/ Investigation has disclosed that under present conditions the project measures will not result in the displacement of any person, business, or farm operation. However, if relocations become necessary, relocation payments will be cost-shared in accordance with the percentages shown.

4. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Jordan Creek Conservancy District (%)	Service (%)	Estimated Construction Cost ($)
Multiple Purpose Channels, Surface Drains, and Waterways	25.0	75.0	1,023,300
Single Purpose Tile Installation	50.0	50.0	109,700

5. The percentages of the engineering costs to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Jordan Creek Conservancy District (%)	Service (%)	Estimated Engineering Costs ($)
All Measures	0	100.0	113,600

6. The Sponsoring Local Organization and the Service will each bear the costs of project administration which it incurs. The estimated costs follow:

Works of Improvement	Jordan Creek Conservancy District	Service
All Measures	$33,050	$220,360

7. The Warren County Soil and Water Conservation District will obtain agreements from owners of not less than 50 percent of the land above each structural measure that they will carry out conservation plans on their land.

8. The Warren County Soil and Water Conservation District will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

9. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

10. The Jordan Creek Conservancy District will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.

11. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

12. This agreement is not a fund obligating document. Financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the availability of appropriations for this purpose.

    A separate agreement will be entered into between the Service and the Jordan Creek Conservancy District before either party initiates work involving funds of the other party. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

13. The watershed work plan may be amended or revised, and this agreement may be modified or terminated only by mutual agreement of the parties hereto except for cause. The Service may terminate financial and other assistance in whole, or in part, at any time whenever it is determined that the Sponsoring Local Organization has failed to comply with the conditions of this agreement. The Service shall promptly notify the Sponsoring Local Organization in writing of the determination and the reasons of the termination, together with the effective date. Payments made to the Sponsoring Local Organization or recoveries by the Service under projects terminated for cause shall be in accord with the legal rights and liabilities of the parties.

14. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

15. The program conducted will be in compliance with all requirements respecting nondiscrimination as contained in the Civil Rights Act of 1964, as amended, and the regulations of the

Secretary of Agriculture (7 C.F.R. 15.1-15.12), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any activity receiving federal financial assistance.

16. This agreement will not become effective until the Service has issued a notification of approval and authorizes assistance.

WARREN COUNTY SOIL AND WATER CONSERVATION DISTRICT

By_____

Title_____

Address_____
Zip Code

Date_____

The signing of this agreement was authorized by a resolution of the governing body of the Warren County Soil and Water Conservation District, adopted at a meeting held on_____

_____
(Secretary, Warren County Soil and Water Conservation District)

Date_____

JORDAN CREEK CONSERVANCY DISTRICT

By_____

Title_____

Address_____
Zip Code

Date_____

The signing of this agreement was authorized by a resolution of the governing body of the Jordan Creek Conservancy District, adopted at a meeting held on_____

_____
(Secretary, Jordan Creek Conservancy District)

Date_____

Appropriate and careful consideration has been given to the environmental statement prepared for this project and to the environmental aspects thereof.

Soil Conservation Service
United States Department of Agriculture

Approved by:

_____
State Conservationist

Date_____

SUMMARY OF PLAN

The Jordan Creek Watershed includes approximately 54.88 square miles in Warren County, Indiana. The drainage originates in Warren County, and flows generally west and southwest into Vermilion County Illinois. Jordan Creek joins the North Fork of the Vermilion River about 5 miles south of Rossville, Illinois.

The project is sponsored by the Warren County Soil and Water Conservation District (SWCD) and the Jordan Creek Conservancy District (JCCD).

Major watershed problems described in the plan are: inadequate land and water management, floodwater damage, erosion and inadequate drainage.

Land treatment measures will be installed by individual landowners and operators. Technical assistance will be provided by the Soil Conservation Service (SCS) and the Indiana Department of Natural Resources (IDNR), Division of Forestry, in cooperation with the U.S. Forest Service.

Land treatment practices considered appropriate for installation in the watershed are: conservation cropping system, contour farming, terraces, diversions, grassed waterways or outlet, minimum tillage, crop residue use, grade stabilization structures, subsurface drains, drainage mains or laterals, pasture and hayland planting and management, ponds, tree planting, and forest land management. These measures include the needed conservation practices required for watershed protection.

The proposed land treatment measures will bring an additional 27,517 acres under adequate treatment. The annual soil loss from 8,400 acres of cropland with an erosion problem will be reduced from 5.7 tons per acre to 3.5 tons per acre. The amount of sediment leaving the watershed will be reduced 63 percent from the present rate of 21,000 tons per year.

The Other cost (All funds other than Public Law 566) of the land treatment measures is estimated at $735,640 which includes $670 for forest land measures. Public Law 566 (PL-566) cost of $18,640 is estimated for technical assistance for the land treatment measures.

Structural measures will consist of approximately 12.2 miles of multiple purpose flood prevention and drainage channel work. This work will be enlargement, deepening and minor realignment. All work will be performed on man-made or modified channels of which 1.9 miles is considered as having perennial flow and the balance intermittent or ephemeral.

Other structural measures consist of approximately 14.7 miles of new or reconstructed open ditches, 46.7 miles of surface drains, 5.1 miles of grassed waterway construction, 19.8 miles of tile in conjunction with surface drains and grassed waterways and approximately 50 grade stabilization structures to provide controlled inlets for grassed waterways and surface

drains into main channel and improved open ditches. Also, about 1.5 miles of debris removal on Jordan Creek main channel is included.

Crop and pasture damages will be reduced by 40 percent, damages to roads and bridges 14 percent, and indirect damages 29 percent; approximately 15,920 acres will benefit from joint floodwater drainage relief.

The structural measures are estimated to cost $1,774,190 of which $1,162,520 is PL-566 cost and $611,670 is Other cost.

The total installation cost is estimated at $2,528,470 of which 1,181,160 is PL-566 cost and $1,347,310 is Other cost.

Total annual cost for installation amounts to $104,570[1]/ Annual operation and maintenance costs of $15,850 will be borne by the sponsors. The total annual cost is $124,020.

Total average annual benefits from structural measures are an estimated $496,060 which includes flood damage reduction benefits of $11,840, more intensive land use benefits of $138,500, agricultural water management (drainage) benefits of $138,500, and local secondary benefits of $207,220.

An 8-year installation period is planned.

The ratio of average annual benefits of $496,060 to the average annual cost of $105,060 is 4.7 to 1.0.

1/ 100 years @ 5-7/8 percent interest.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Physical resources

Jordan Creek Watershed contains an area of approximately 35,123 acres or 54.9 square miles and is located in northwestern Warren County, Indiana.1/ Relative locations of some important cities follow: Danville, Illinois, 12 miles southwest; Hoopeston, Illinois, 13 miles west; Hammond, Indiana, 75 miles north; Lafayette, Indiana, 30 miles east; and Indianapolis, Indiana, 75 miles southeast.

The watershed is not within any Standard Metropolitan Statistical Area (SMSA). The 1970 census shows Warren County, Indiana, to have a population of 8,705. The county is classified as rural with the population listed as 76.4 percent rural non-farm and 23.6 percent rural farm. Estimated population of the watershed is 704 with approximately 7 percent occupying the unincorporated villages of Tab, Stewart and Pence, Indiana.2/

Present land use within the watershed with approximate acres and percent is as follows: cropland, 94.5 percent (33,200 acres); pasture, 1.8 percent (640 acres); forest land, 0.1 percent (25 acres); and other, 3.6 percent (1,260).

A high level of agricultural production may be sustained even though a certain amount of soil is lost each year to erosion. The tolerable limit of soil loss is being exceeded on 8,400 acres of cropland scattered throughout the watershed. An additional 26,800 acres of cropland is on mineral soils having a wetness limitation for crop production.

An average of 1,390 acres is affected annually by overbank flooding. Approximately 15,920 acres have joint, inseparable flooding and drainage problems.

The climate within the watershed is typical of the region. Average annual precipitation is about 37 inches. Distribution is nearly cyclic, varying from a low monthly average of 2.26 inches in February to a high of 4.66 inches in June. Fifty percent of the precipitation falls in the growing season, often as high intensity rainfall. Snowfall varies considerably from year to year, but averages 24 inches with 4 to 5 inches each month from December through February.

1/ All information and data, except when otherwise noted by reference to source, were collected during watershed planning activities by the Soil Conservation Service, and Forest Service, U.S. Department of Agriculture.

2/ 1970 Census of Population, Advance Report, PC (VI) - 16, Indiana: U.S. Department of Commerce, Bureau of the Census, December 1970.

Physical resources--cont'd

Average daily maximum temperatures range from a low of 37° in January to a high of 87° in July. Average daily minimums range from a low of 23° in January to a high of 65° in July. Average daily temperature ranges from 29.7° in January to 76.3° in July. An average of 30 days per year has a maximum temperature over 90°, and the temperature falls below freezing an average of 120 days. The growing (frost-free) season averages 170 days. Average annual sunshine is 2,650 hours. There are usually 45 days a year with thunderstorms.1 & 2/

This watershed is within National Land Resource Area (NLRA) 110, the Northern Illinois and Indiana Heavy Till Plain. 3/ It is also covering central Indiana and characterized by nearly flat to gently rolling topography that has undergone slight modification by post-glacial streams. The altitude ranges between about 675 feet above mean sea level near the Indiana-Illinois state line to about 830 feet in the extreme northeastern part of the watershed, a maximum relief on the order of 155 feet. Local relief ranges from a few feet to about 50 feet, averaging somewhat less than 20 feet over much of the watershed.

The thickness of glacial drift ranges between approximately 100 and 200 feet. The surficial glacial materials consist predominatly of fine-grained glacial till in the form of ground-moraine and end-moraine deposits.4/

Small, scattered areas of kame deposits (ice-contact stratified gravel, sand and silt) and lacustrine deposits of muck, peat or marl are present within the watershed. Alluvial silts, sands and gravels associated with valley-train deposits of gravel and sand are present along much of Jordan Creek.

Soils in the watershed are shown on the General Soils Map by soil association. A soil association is a landscape that has a distinctive proportional pattern of soils. It consists of two or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

1/ Annual summary, Climatological Data Indiana: U.S. Department of Commerce, NOAA, EDS, vol. 76, November 13, 1971.

2/ The National Atlas of the United States of America: U.S. Department of the Interior, USGS, 1970

3/ "Land Resource Regions and Major Land Resource Areas of the United States," Atlas of River Basins of the United States, USDA, SCS, 1970

4/ Geologic Map of the 1°X2° Danville Quadrangle, Indiana and Illinois Showing Bedrock and Unconsolidated Deposits, Regional Geologic Map No. 2, Indiana Geological Survey, 1966.

Physical resources - cont'd

The table "Estimated Soil Limitations or Suitabilities for Selected Uses" is to be used in conjunction with the General Soils Map. The table lists the percentage of each soil association and the limitations and suitabilities of the major soils for specific land use.

The General Soils Map, limitation table and soil association descriptions are found in exhibits 7A through 7D.

Bedrock of Pennsylvanian age crops out beneath the glacial drift. The dominant lithologies are sandstone and shale with lesser amounts of limestone, clay and coal.

There are no mineral resources being mined or produced in the watershed. Some sand and gravel is present in the outwash deposits and widely scattered stratified drift. Neither of these resources is being commercially utilized. Although the Minshall Coal is present in the Pennsylvanian bedrock, the quality and quantity of the coal resources is such that mining is not likely to occur. 1/

All lateral ditches and the upper reaches of Main Jordan are intermittent (continuous flow through some seasons but little or none through others) and man-made or modified. The remaining streams are perennial (flows at all times except during extreme drought) and man-made or modified.

There are no known areas of wetland types 3, 4, or 5 in the watershed.2/ The areas that receive annual flooding and depressional ponds in the upper reaches are classified as type 1 wetlands. Cropland comprised approximately 80 percent of these wetlands with the remainder being grassland and other land.

Reach E of Jordan Creek begins at the Indiana-Illinois state line and proceeds upstream in Indiana to the junction of the Little Jordan Creek.

Upstream from the state line the channel is shallow and flat bottomed, about 50 feet in width, and 3 to 1 side slopes with the flood plain being in cropland. The channel northwest of Pence, Indiana, has a flat bottom with a double channel creating a wooded island and pastureland and cropland on the field sides. The channel is 4 to 8 feet deep with varying side slopes from 2:1 to 4:1. The flood plain gains width and the entrenchment

1/ Harold C. Hutchinson, Distribution, structure, and mined areas of coals in Fountain and Warren Counties and the northernmost part of Vermillion County, Indiana, Preliminary Coal Map No. 9, Indiana Dept. of Conserv., Geol. Serv., 1961.

2/ Wetlands of the United States: U.S. Dept. of the Interior, Fish and Wildlife Service, Circular 39, 1971.

Physical resources - cont'd

becomes shallower. The forest land is less dense but the reach contains a higher percentage than the remainder of the watershed. North and east of Pence to the end of Reach E the channel varies in width but averages approximately 4 feet in depth. The flood plain contains scattered trees and grasses with pastureland being the primary land use.

Reach C, beginning at the junction of Little Jordan Creek and ending at the junction of Leak Ditch, has a V-shaped valley. The channel averages about 25 feet in width but is 4 to 7 feet deep with 2:1 side slopes. There are some trees scattered along the channel and limited pasture in the lower levels of the flood plain, but the flood plain is predominantly cropland.

Reach B beginning at the junction of Leak Ditch proceeding upstream on Jordan is no longer entrenched but is a drainage ditch with side slopes of about 2:1. The channel varies in width from 16 feet to 2 feet and is trapezoidal in shape with depths of 2 feet to 5 feet.

Reach A from the junction of Jordan Creek upstream on Leak Ditch is a drainage ditch and is trapezoidal with the following approximate dimensions: depth--4 feet, side slopes--2:1 and width--10 feet.

Reach D from the junction of Jordan Creek upstream on Little Jordan Creek is a drainage ditch, trapezoidal in shape, ranging in bottom width from 20 feet to 10 feet and having 2:1 side slopes with a depth of approximately 4 feet.

Reaches A, B and C, Leak Ditch, Jordan and Little Jordan Creek are man-made channels for removal of surface and subsurface water to enhance the agricultural development. Sedimentation has occurred in portions of these channels since their early construction.

There are no stream gages in the watershed. The nearest gage is downstream on Vermilion River in Danville, Illinois, and serves an area of 1,280 square miles. Jordan Creek Watershed contributes only 10 percent of the drainage area of the gage.

Groundwater resources

Groundwater resources are sufficient for local needs in the watershed. Locally good supplies are obtained from sand and gravel deposits located within the glacial drift. These sand and gravel deposits usually provide adequate water for rural, domestic and livestock use. Well yields are normally in the range of 50 to 150 gallons per minute. 1/

The town of Pence, located near the lower end of Jordan Creek (one mile east of the Indiana-Illinois state line), has a municipal water supply system. Two wells drilled 115 feet deep supply 100 people with an estimated 36,600 gallons per day. The physical and chemical characteristics are as follows. 2/

	Unit	
pH	No.	7.0
Color (S.U)	Color Units	5
Turbidity (S.U.)	Jackson Units	0.2
Hardness ($CaCO_3$)	Mg/l	298
Calcium (Ca)	Mg/l	72
Magnesium (Mg)	Mg/l	28
Sodium (Na)	Mg/l	46
Potassium (k)	Mg/l	5
Iron (Fe)	Mg/l	0.8
Manganese (Mn)	Mg/l	0.04
Alkalinity	Meg/l	396
Chlorides	Mg/l	3
Sulfates (SO_4)	Mg/l	2
Nitrates (N)	Mg/l	0.1
Fluorides (F)	Mg/l	0.3

As part of a biological review, the IDNR, Division of Fish and Wildlife made a simple water quality assessment of Jordan Creek in December, 1974. They found a temperature of 51° F, dissolved oxygen content of 12 ppm, and a pH of 8.0. They stated that water quality appeared good in the area, and the stream bottom looked quite productive. 3/

The USGS, Water Resources Division in Indianapolis conducted a water quality assessment of the watershed to delineate existing and potential water quality problems.

1/ Unpublished material prepared for the State Water Plan by the Groundwater Section, Division of Water, IDNR.

2/ Indiana State Board of Health, Data on Indiana Public Water Supplies, Bulletin #S.E. 10, 1968.

3/ Jordan Creek Stream Survey Report, IDNR, Division of Fish and Wildlife, December 1974.

Groundwater resources - cont'd

Reconnaissance sampling was conducted at nine sites on September 24, 1974. All nine samples were taken directly from the streams. Field water quality and stream flow measurements were made, and samples were collected for laboratory analysis for some or all of the following: common inorganic constituents, selected metals, nutrients, bacteria, insecticides and certain fractions of the biologic community. Water quality and analytical data is found in Exhibit 11.

For the most part, stream waters in Jordan Creek watershed were of good quality and were similar with respect to specific conductance and concentrations of dissolved solids, major cations, and major anions.

Temperature, pH, and dissolved oxygen content were typical of the times and existing flow conditions.

Dissolved manganese exceeded that desired for water supply, but was well within the limitation for agricultural uses.

Nutrient concentrations, nitrate, phosphate, and organic carbon were typical for an agricultural watershed and should not be a problem with respect to public use. The data gathered indicate nutrient levels are not likely to cause enrichment and undesirable biologic growth; however, higher concentrations of nitrate during winter and spring flows could present a slight problem.

Fecal coliform and fecal streptococci bacteria concentrations measured in the watershed were moderate and very low, respectively. Concentrations indicate some contamination from sewage effluent and animal wastes, but levels were not alarmingly high.

Low concentrations of dieldrin, DDD, and DDE were found in bottom samples of Jordan Creek. These concentrations have the potential for accumulating in local biological food chains; however, present concentrations have not affected biological index. Future levels of concentrations are not expected to be alarming. 1/

1/ A Water-Quality Assessment of the Jordan Creek Watershed, Warren County, Indiana, USGS, Water Resources Division, Indianapolis, 1975.

Economic resources

Principal economic activity in the watershed is agriculture. The agricultural area is under private ownership. Cash grain is the major farm enterprise. There are 184 farms in or partially in the watershed. Eighty-two are covered by cooperative agreements and have conservation plans with the Warren County Soil and Water Conservation District. The average size farm is 320 acres with the average farming unit being about 480 acres.

Current overall watershed land use is distributed 33 percent to corn, 17 percent to soybeans, 17 percent to wheat, 23 percent to meadow, 2 percent to sweetcorn, 3 percent to permanent pasture and 5 percent to forest and other uses. Crop yields for the watershed as a whole average 120 bushels--corn, 37 bushels--soybeans, 42 bushels--wheat, 3.5 tons--hay, and 5 tons--sweetcorn. Yields reflect a combination of productive soil, good management and adequate capital.

Land values vary in the watershed. The average value of upland is $1,500 per acre, flood plain land is $700 per acre and $1,000 per acre for land with drainage problems.

Access to trade and market outlets is provided through a well developed network of roads. Indiana State Road 26 joins Illinois 9 to provide watershed access to points east and west. North-south traffic is served by Illinois State Road 1 to the west of the watershed and U.S. Highway 41 east of the watershed. Approximately 110 miles of county roads supplement these principal traffic arteries. Railroads serving the area are the Chicago and Eastern Illinois and the Penn Central.

Unemployment is not a problem in the watershed. Many of the farms employ full-time hired help or seasonal part-time help.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Plant and animal resources

The watershed contains approximately 94.5 percent cropland, 1.8 percent pasture land, 0.1 percent forest land and 3.6 percent other. the cropland is used primarily for production of corn and soybeans and is evenly distributed throughout the watershed.

A large portion of the pasture land is found in the lower reaches of the watershed in the floodway. This pasture was originally established in the floodway to minimize crop losses caused by periodic flooding. The remainder of the pasture land is evenly distributed throughout the watershed.

All of the forest land is privately owned with only 25 acres being located in the watershed. The average forest land is unevenly distributed with concentrations in the downstream portions along the creek bottoms and adjacent upland. Stands are predominantly hardwood with the principal forest type oak-hickory. About 70 percent of forest stands are sawtimber size, 10 percent pole size, and the remaining 20 percent understocked. Adequate forest fire protection is provided by the Indiana Department of Natural Resources in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program.

Wildlife habitat provided by the woody cover is limited in extent, however, it is quite desirable in quality for those wildlife species most predominant in the watershed. For the most part woody habitat is found adjacent to the streams and along railroad rights-of-way.

The IDNR, Division of Fish and Wildlife census information shows populations of cottontail rabbit as light to moderate, bobwhite quail as light to moderate, ring-neck pheasant as moderate, squirrel as light, and deer as light over most of the watershed.

Ring-neck pheasant hunting is most important and accounts for over 80 percent of all hunting efforts in the area. Pheasants and bobwhite quail are common in grassy areas at the edge of woods, in the more open woods and throughout cornfields. Rabbit, squirrel and quail hunting comprise most of the hunting within the watershed.

Other important game and fur species which occur in the watershed include woodcock, raccoon, muskrat, opposum, striped skunk, red fox, and mink. See Exhibit 9 for mammals occurring in the vicinity.

Plant and animal resources - cont'd

Populations of aquatic wildlife are light due to the general lack of wetland habitat throughout the watershed. However, several small type 1 wetlands are scattered throughout the topography in the form of depressional areas.

Songbirds of over 100 species use the limited woody cover which serves as a safe travel lane through large areas of cropland. Tall trees are nesting places for the great horned owl, red-tailed hawk, Baltimore oriole, scarlet tanager and many others. Dead and mature hollow trees provide suitable nesting sites for wood duck and invite flickers, red-headed woodpeckers, bluebirds, sapsuckers, house wrens and up to 35 other species of birds that use den trees. Shrubby border and fence rows attract the cardinal, mockingbird, catbird, cedar waxwing, brown thrasher indigo bunting, goldfinch, song sparrow, vireo and chipping sparrow. See Exhibit 9 for species of wildlife identified within the watershed.

The sport fishery in Jordan Creek is limited due to the silted condition of the channel. Most of Jordan Creek consists of low gradient, heavily silted channels except for a short stretch immediately above and below the confluence of Little Creek and Jordan Creek.

A simple water quality assessment was made during the fishery survey by IDNR. Water quality approved satisfactory for fish production with approximately 12 ppm dissolved oxygen and pH of 8. 1/ Data gathered by USGS, Division of Water, indicated nutrient levels are not likely to cause enrichment and undesirable biologic growth. Higher concentrations of nitrate during winter and spring flows could present a slight problem. The higher concentrations of nitrate should not be detrimental to the sport fishery.

Low concentrations of dieldrin, DDD, and DDE have the potential of accumulating in local biological food chains, however, present concentrations have not affected the biological index. Present biological condition in the stream is good. Future concentration levels of insecticides are not expected to be alarming. 2/

1/ Jordan Creek Watershed Fishery Survey Report: IDNR, 1974

2/ A Water-Quality Assessment of the Jordan Creek Watershed, Warren County, Indiana. USGS, Water Resources Division, Indianapolis, 1974.

Plant and animal resources - cont'd

The following is taken from the IDNR Fishery Survey Report:

> "The present 'natural' section of the stream is so small in relation to the 'modified' section that in its present condition Jordan Creek can neither support a significant sport fishery nor maintain much vestige of a 'natural' stream population. However, if the extremely silted condition of the stream channel could be corrected and maintained, it is quite possible that the fish population (both game and nongame) will show marked improvement.
>
> Because reduction of silt is one of the objectives of the proposed project it is important to retain as much of the 'natural' portion of the stream as possible to serve as a spawning and rearing area. Following completion of the channeling project this portion of the stream could be stocked with game fish.
>
> Loss of the productive, hard-bottomed, natural portion of the stream could mean loss of valuable invertebrate population. If the natural portion of the stream could be retained existing populations could serve as an invertebrate source for repopulation of the newly 'cleaned' channel."

No rare or endangered species have been identified as being dependent upon habitat conditions in this watershed.

Most of the land within the watershed is privately owned and public access to the existing resources is available only by permission of the landowners.

Recreational resources

There are no existing private or public recreational enterprises located in the watershed. The watershed is predominately agricultural with 94.5 percent of the land use being cropland and only 0.1 percent forest land.

No potential areas have been identified for major recreational development in Indiana. 1/ However, to a limited extent, individual recreation activities such as bird watching and hiking exist along the lower reaches of Jordan Creek in Indiana. Hunting of ring-neck pheasant is common throughout the watershed.

There are existing needs for picnic areas, camping areas, playfields, bicycling paths, horseback riding trails, nature walks, hunting

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1/ Warren County Soil and Water Conservation District, An Appraisal of Potentials for Outdoor Recreational Developments in Warren County, Indiana, (undated).

Recreational resources - cont'd

areas, swimming areas, and fishing waters in the watershed. The items mentioned would be consistent with the potential resources that exist within the watershed. 1/

Archaeological, historical and unique scenic resources

There are no entries for Warren County, Indiana in the National Register of Historic Places and Natural Areas in Indiana and their Preservation. 1/ & 2/ The Indiana Guide to Historic Places lists several places of historic interest in the county; however, none of the sites are located within the watershed. 3/ There are no known sites eligible for inclusion in the National Register of Historic Places.

An archaeological study by the Indiana Historical Society was completed in May 1975. Twenty-eight sites were identified. 4/ Eight of these sites were found within the temporary easement and could possibly be disturbed. However, only 4 sites were considered to be significant enough to retain in their natural state or be salvaged. The other 20 sites lay outside of the easement area.

The survey revealed that much of the watershed area was once part of the Arcadia hunting grounds. A predominance of the diagnostic material found belongs to the Archaic Tradition, which dates from 8,000 B.C. to about 1,000 B.C. Later habitation by Woodland and Mississippian populations is only poorly represented if at all. There was no evidence of either a single large or long-term occupation of the sites.

Where the 4 sites with significant value would be affected by the proposed works of improvement, proper procedures will be taken to preserve these sites by altering construction.

The State Historic Preservation Officer and the National Park Service will be notified if artifacts or other items of archaeological or historical significance are uncovered during construction.

1/ National Register of Historic Places: National Park Service, Feb. 1973.

2/ Natural Areas in Indiana and Their Preservation: Department of Biology, University of Notre Dame, May 1970.

3/ Indiana Guide to Historic Places: Indiana Department of Commerce, 1973.

4/ Archaeological Survey of the Jordan Creek Watershed: Indiana Historical Society, 1975.

WATERSHED RESOURCES - ENVIRONMENTAL SETTING

Soil, water and plant management status

The present trend in land use is essentially stable with only a slight decrease each year in cropland and pasture. Forest land remains the same with a slight increase in other land. Changes during the life of the project are summarized below:

	Cropland	Pasture	Forest Land	Other Land
Present	33,198	640	25	1260
Future	33,185	631	25	1282
Change	-13	-9	0	+22

The change in land use as indicated above is attributable to economic and technical conditions rather than project action. Some factors involved in the change are: the high cost of land, equipment, labor and capital. These factors have combined to encourage the farm operator to specialize (produce one commodity) instead of diversify (produce several commodities). The comparatively low profit margin in livestock production is expected to result in the conversion of some pasture to cropland. Also, long term investment pressures and a general shortage of readily available or accessible cropland will tend to encourage the farm operator to remove timber from the present forest land that can be used as cropland. In summary, the future change in land use is not project oriented.

Adequate local funds are available for applying needed individual farm land treatment practices. There is a shortage of local contractors to apply conservation practices.

Approximately 26,800 cropland acres of mineral upland soil have an inherent drainage problem that has been partially corrected. Additional drainage is needed for most efficient use of this land as cropland.

Soil loss on 8,400 acres of gently to moderately sloping cropland exceeds tolerable limits. This excess soil loss decreases the productivity of the land, increases production costs of crops and contributes to downstream sediment pollution. Adequate conservation practices will be applied to reduce average annual soil loss to a tolerable limit of 3.5 tons per acre.

The watershed is serviced by the Warren County Soil and Water Conservation District, which provides technical assistance to landowners and operators in the preparation of conservation plans and the application of land treatment measures.

Soil, water and plant management status - cont'd

Adequate forest fire protection is provided for the forest land by the IDNR, Division of Forestry in cooperation with the U.S. Forest Service through the Clarke-McNary Cooperative Forest Fire Control Program.

There are 184 farms in the watershed and 123 (67 percent) of the farms have conservation plans with the soil and water conservation district.

Acres and percentages of land considered adequately treated by land use are: 6,450 acres cropland, 19 percent; 260 acres pasture, 63 percent; 10 acres forest land, 40 percent; and 590 acres other, 98 percent. This represents 7,345 acres which comprise 21 percent of the total watershed.

Conservation practice units needed in the watershed and percent applied on the land are as follows:

Practice 1/	Practice Unit Needed	Percent Applied
Contour Farming	340 Ac.	85%
Grade Stabilization Structure	80 No.	26%
Grassed Waterway or Outlet	100 Ac.	30%
Conservation Cropping System	26,000 Ac.	39%
Minimum Tillage	27,300 Ac.	32%
Crop Residue Use	18,000 Ac.	40%
Subsurface Drains	323,840 Ft.	20%
Pasture and Hayland Management	150 Ac.	57%

Cost sharing for some conservation practices is available through the Agricultural Stabilization and Conservation Service which administers the Agricultural Conservation Program.

1/ See Exhibit 1 for definition of practices.

WATER AND RELATED LAND RESOURCE PROBLEMS

Land and water management

Many areas of the watershed now under cultivation have soils with erosion problems and drainage limitations. The ability of these soils to sustain efficient production depends on the establishment and maintenance of needed conservation measures. (See Exhibit 2)

Flooding and drainage is a problem on approximately 15,920 acres in the watershed. The average annual area subject to overbank flooding is 1,390 acres.

Most severely affected within the water problem area are scattered surface depressions and low areas adjacent to inadequate channels. Damaging effects are expressed through impaired root and plant growth, increased disease, greater competition from weeds, reduced crop quality and delayed field work. Low economic returns do not permit the landowners to apply management for top efficiency.

Overall economic capabilities of landowners and operators present no limitation to application of conservation practices. There is a need for additional conservation contractors. However, this factor is not expected to seriously delay implementation of needed practices.

There is a continuing need for information and education programs to effectively reach and motivate the landowners and operators who must carry out the land treatment measures.

Floodwater damage

Frequent flooding occurs on land adjacent to principal watershed drainage channels. Flood problems are most severe on Leak Ditch from the vicinity of Tab, Indiana, (Reach A) downstream to its junction with Jordan Creek; on Jordan Creek from Tab (Reach B) downstream to Pence (Reach E); and on Little Creek (Reach D) from the vicinity of Stewart, Indiana, downstream to its junction with Jordan Creek.

Areas flooded vary in width from a few hundred feet to a maximum of one quarter mile. Approximately 1,881 acres of land within the watershed are inundated by a large flood (100-year frequency), 1,069 acres by a medium size flood (5-year frequency), and 514 acres by a small flood (1-year frequency).

Land use within the flood plain is primarily agricultural. Of the total area subject to flooding 45 percent is cropland, 42 percent pasture land, and 13 percent woodland and other land. Corn occupies two-thirds of the cropland acreage and soybeans one-third.

Floodwater damage - cont'd

Greatest concentrations of cropland occur along Leak Ditch and Jordan Creek in the vicinity of Tab, along Jordan Creek, and along Little Creek. Cropland in these areas accounts for 70 to 75 percent of the flood plain. Cropland in other flood plain areas ranges from 35 percent on Jordan Creek Reaches C and E to 15 percent on the most downstream segments of Jordan Creek.

Damages occurring on agricultural areas from overflow include reduced crop and pasture yields, increased crop production costs, and increased maintenance expenses on flood plain improvements. Annual value of future crop and pasture damages without project average $11.47 per flood plain acre. Constraints to flood plain land use and crop production processes are a factor on Jordan Creek (Reaches C and E).

Flood damages to nonagricultural values are reflected primarily as increased road and bridge maintenance expense. In total, 17 county roads and 8 railroad bridges cross the channels within the flood zone outlined at the beginning of this section. Damages on an annual basis are, for the most part, insignificant on railroad bridges. Damages to county roads and bridges in the watershed typically occur yearly.

Erosion damage

Erosion is not a severe problem in the watershed. The greatest soil loss occurs on about 8,400 acres of cropland which is susceptible to sheet erosion. The estimated average soil loss is 5.7 tons per acre annually. The average soil loss tolerance is approximately 3.5 tons per acre annually. About 26,800 acres of cropland occur on depressional soils which normally yield very minor quantities of sediment. The estimated average soil loss from the total cropland acreage of the watershed is about 1.4 tons per acre annually.

Streambank erosion contributes an estimated 5 percent of the gross erosion. Erosion from roadside ditches, built-up areas, and farmsteads contribute an estimated 5 percent of the total gross erosion within the watershed. There is some wind erosion within the watershed due primarily to fall plowing, a common practice in the watershed.

The major soil erosion areas are scattered throughout the two soil associations (Sidell-Dana-Darroch and Raub-Chalmers-Darroch). associations parallel the streams and extend along the east edge of the watershed.

Sediment damages

Sediment damages are not a severe problem. Some roadside ditches and drainage channels accumulate sediment. However, the problem is minor in relation to the total floodwater and drainage problems. Improved agricultural management practices and the application of needed land treatment measures should alleviate the problem of sediment accumulation in roadside ditches and drainage channels.

Sediment yield from the watershed is estimated at approximately 12,000 tons annually (about 0.33 tons per acre annually).

Joint problems (flooding and drainage)

Agricultural drainage problems exist because of shallow channels and lack of channel capacity. Open and closed drains are restricted during floods. The most significant problems are recurring patterns of drainage impairment and flooding which occurs throughout the growing season. Damaging effects are expressed through impaired root and plant growth, increased plant disease, greater competition from weeds, reduced crop quality and delayed field work. Reach A contains 2,107 acres with joint problems; Reach B, 4,521 acres; Reach C, 1,709 acres; Reach D, 4,715 acres; Reach E, 2,368 acres; and Reach J, 504 acres.

Due to the existing flooding and drainage problems, crop production costs are higher and crop yields are lower when compared with production on land without these problems. Thus, less maintenance, labor, and material are applied by landowners and operators in the problem areas. Average annual yields in the area affected by poor drainage outlets are reduced by an estimated 26 bushels per acre for corn and 12 bushels per acre for soybeans.

The lack of adequate drainage outlets in the upper reaches of Little Creek, Leak Ditch, and Jordan Creek has resulted in a large portion of these drains becoming unserviceable. In some sections, drains are now inadequate for either passage of floodwater or to serve as suitable drainage outlets. Additional depth and capacity are needed to provide adequate outlets on the upper reaches of all three tributaries.

The most severely affected problem areas studied are scattered surface depressions and low areas adjacent to inadequate channels. These areas for ease of future discussion will be labeled Problem Sub-Area 1. Storm runoff concentrations in these areas remain for prolonged periods of time. Crop yields are greatly reduced, and complete crop failure is frequently a result of prolonged ponding.

Joint problems (flooding and drainage) - cont'd

Surrounding these areas of severe water problems are fringe areas of soils which, although not subject to ponding or flooding, remain saturated for long periods of time (Problem Sub-Area 2). Yields in these areas, although acceptable, do not reflect the inherent production potential of the soil. Yields of row crops are depressed on an average of 20 to 30 percent due to the drainage problems.

Reduced crop yields are experienced on still other portions of the overall water problem area. These areas are designated here as Problem Sub-Area 3. This area often occurs on the landscape in close association with Problem Sub-Areas 1 and 2, but may occur separately as well. For the most part, their margins follow normal field boundaries. They represent areas where less than optimum timing of field operations are possible due either to the presence of Sub-Areas 1 and 2 within a given field, or to the presence of random areas of imperfect drainage. Extent of current yield reductions on these areas is not highly signficant--5 to 10 percent. However, with an ever increasing level of technology, it is expected that the yield limitations presented by disruptions in the timing of field operations will become increasingly more significant.

Recreational problems

Individual recreation activities such as hunting, bird watching, hiking, nature walks, fishing, and picnicking, with the landowners' permission, are the only activities available to the general public in the watershed.

There are no surface water areas in the watershed for use by the public. There are two privately existing ponds in the watershed.

The watershed is in the Bureau of Economic Analysis Areas 058 and 059. Warren County lies in Area 059 which has a projected population of 388,800 for the year 2000 compared to 249,412 in 1969.

Present recreation needs for these areas include the following facilities: hunting areas, nature and hiking trails, horseback riding paths, bicycling paths, camping areas, and picnicking areas. Needs exist for water-related activities such as fishing, swimming, boating, water skiing, and canoeing. There appears to be available resources to meet all needs except for water-related recreation.1/

1/ State of Indiana, Shaping the Future, Indiana Recreation Plan, September 1970.

Plant and animal problems

The original vegetation for the area was primarily prairie grass. The minimal amount of forest land and wildlife and recreation land present provides very limited cover for wildlife. The Chicago and Eastern Railroad right-of-way is in the process of being returned to cropland by private owners. The loss of the old railroad right-of-way along with channel work for flood control and drainage will be detrimental to the existing wildlife resources. A continuing detrimental effect will last the life of the project unless redevelopment is planned, established, and maintained. An improved balance of land use to provide fish and wildlife habitat is desirable.

Since 94.5 percent of the watershed is cropland, the wildlife will be substantially influenced by the agricultural land use and management practices. Farm ponds, wildlife habitat development and erosion-control practices that establish vegetative cover are beneficial to wildlife.

The forest land ownership pattern is scattered, and only 25 acres of forest land occur in the watershed. The narrowness and limited length of much of the wooded areas along the streams reduce their importance for large mammals, such as white-tailed deer, but small mammals, birds, reptiles, and amphibians make use of these areas. The present hydrologic condition of the forest land varies from very poor to poor; however, the potential of this land to improve hydrologically is high. Livestock grazing has eliminated ground cover in certain areas, exposing the soil to erosion; however, erosion and sediment yields are minimal. The primary problem is bringing woodland under improved management.

The watershed is short of surface water as habitat for fish and wildlife and recreational use. Any substantial increase in installed and managed fishery waters would benefit these resources.

Water quality in the streams is good except for small quantities of agricultural sediment and chemicals (see Environmental Setting - Physical Resources).[1/]

Economic and social problems

The median income per family in Warren County, Indiana, for 1970 was $8,340. The median income per family for the State of Indiana in 1970 was $9,970. The median income for all farm families in the county was $8,293 and for the state was $8,198.[2/]

1/ A Water Quality Assessment of the Jordan Creek Watershed, Warren County, Indiana, USGS, Water Resources Division, Indianapolis, 1974

2/U.S. Department of Commerce, General Social and Economic Characteristics, 1970

Water quality problems

Water quality is generally good for agricultural use although fertilizers and insecticides are potential problems. A detailed account of water quality is presented in the Watershed Resources - Environmental Setting, Physical Resources section.[1/]

1/ A Water Quality Assessment of the Jordan Creek Watershed, Warren County, Indiana, USGS, Water Resources Division, Indianapolis, 1974.

PROJECTS OF OTHER AGENCIES

Lake Vermilion, the 690 acre major water supply for Danville, Illinois, is located on the North Fork of Vermilion River 13 miles downstream from Jordan Creek. No benefits are expected to accrue to the Jordan Creek project from Lake Vermilion. However, the installation of sediment traps during construction of Jordan Creek, immediate revegetation of disturbed areas during construction, and the long term effect on reduction in sediment delivery downstream from Jordan Creek as a result of installation of additional land treatment measures should enhance the Lake Vermilion project.

(The Jordan Creek Watershed project is an action-pending project for the Comprehensive Coordinated Joint Plan (CCJP) developed by the Ohio River Basin Commission for the Wabash Basin. Adoption into the CCJP is expected upon completion of the final work plan and environmental impact statement.)[1/]

There are no other water resource development projects in operation or being considered by other agencies or groups that would affect or be affected by the installation of measures proposed in this work plan.

1/ Wabash River Basin Comprehensive Study, Vol. 1, Main Report, June, 1971.

PROJECT FORMULATION

Introduction

Relief from standing water and the need for improved drainage has long been recognized as a need for the Jordan Creek Watershed. Action to provide relief for the watershed was initiated in the mid-forties. Records indicate that the Soil Conservation Service was contacted at that time to study the needs and provide a solution for the problems of water management.

An application for planning assistance under PL-566 for the Indiana portion was submitted in 1959. This application was not approved by the SCS since there were no provisions to include the Illinois portion for overall formulation and it was believed that the Illinois portion was needed for an outlet for any work in Indiana.

An amended application was prepared in 1964 that included the entire drainage area of the watershed. This application was approved by the Illinois Department of Agriculture and the Indiana Department of Natural Resources. Subsequent approval was given by the SCS in August 1964.

A preliminary investigation report was completed in September 1967. The report emphasized work on channels. Work was considered for about 10.5 miles of main Jordan to within about 2 miles of its junction with Middle Branch. Also considered was about 2.4 miles of Little Creek and 3.9 miles of Leak Ditch in Indiana and 7.7 miles of Middle Branch, mostly in Illinois.

To carry out the general formulation of the preliminary investigation report, the Jordan Creek Conservancy District in Indiana was organized in February 1969. An effort to form a similar organization in Illinois failed through referendum vote.

The watershed was authorized for planning by the SCS in April 1969.

First, there was a need for a proper sponsor in Illinois to carry out any works of improvement that were necessary in that state for overall watershed development. It was finally agreed that the Pleasant Hill Drainage District would provide the necessary sponsorship for the main Jordan Creek work and a small amount of lateral work that would be done in Illinois.

A series of discussions involving personnel from the Indiana Department of Natural Resources, Illinois Department of Conservation, U.S. Fish and Wildlife Service, Soil Conservation Service, and local interests were

Introduction - cont'd

held throughout 1971. The purpose of these meetings was establishment of criteria as provided in a 1971 SCS memorandum for mitigation of fish and wildlife losses resulting from project action.

Stability of the main channel where work was proposed was a matter of concern. Additional soil borings were made in 1970. Calculations for stability analysis were made in the late part of 1971. At a meeting of SCS personnel held September 1972, at the SCS Technical Service Center at Lincoln, Nebraska, agreement was reached for the appropriate methods to cope with the potentially unstable condition resulting from planned channel work.

In June 1972, an initial plan was developed which consisted of 43.0 miles of open channel work, 58.5 miles of surface drains and grassed waterways, and 20.5 miles of tile drains with some surface drains and grassed waterways. The work on the main channel extended down to the Chicago and Eastern Illinois Railroad about 5 miles east-southeast of Rossville, Illinois. Most of the benefits accrued to the Indiana portion of the watershed would have resulted from the installation of the upstream measures. The general design of the planned water management features emphasized a fairly fast excess water removal rate.

The planned project caused induced flows along the lower reaches of the main channel, especially for the infrequent, high volume rainfall events. The Pleasant Hill Drainage District attempted in vain to obtain required flowage easements below the project cutoff where induced flows were estimated to occur.

A meeting was held at Williamsport on January 17, 1974. Inability to obtain the required easements was discussed. The sponsors requested the SCS to study alternatives to the June 1972 draft that could eliminate the problem caused by downstream induced stages and the land rights situation.

On September 11, 1974, a meeting was held at Pence, Indiana, with local people and SCS personnel from both states in attendance. A project alternative was discussed whereby most of the main channel work would be eliminated from a point about 3 miles upstream of the state line and proceeding downstream to the cutoff of the June 1972 draft plan at the Chicago and Eastern Illinois Railroad. Remaining channel work would be reduced in size to diminish the rapid water removal rate that was previously planned. In addition, the land treatment program would receive greater emphasis for those practices that would reduce surface runoff.

Introduction - cont'd

The overall effects would reduce greater project-induced flows and eliminate any induced flows across the state line. The sponsors agreed that this approach provided the best means to implement needed project measures for the solution of their water management problems.

In February 1975, both sponsors in Illinois, the Vermilion County Soil and Water Conservation District and the Pleasant Hill Drainage District, requested to withdraw from the proposed project.

The work plan includes only those measures proposed within the State of Indiana.

Objectives

The project sponsors expressed as objectives for development in the Jordan Creek Watershed the following items: 1) reduce flood damages, 2) improve drainage, 3) reduce road and bridge damage, 4) control erosion and sedimentation, 5) improve fish and wildlife habitat and 6) develop outdoor recreation facilities.

The Warren County Soil and Water Conservation District will encourage methods for erosion and water runoff control. Their goal is to have at least 27,517 acres (78 percent) of the total watershed area adequately treated by the end of the project installation period.

Another goal of the sponsors is to provide for the safe and timely removal of excess water from flood plain and depressional areas. The opportunity for subsurface water removal for all areas in need is also desired as a part of project works of improvement.

The primary concern of residents along the major channels is relief from flooding. A one-year cropping season level of protection is considered adequate to meet their needs. Complete water removal from all other areas within a 24-hour period is the general objective of the sponsors.

Methods of solving the watershed problems, other than channel work, were considered during work plan studies. The watershed topography is too level to allow the use of retarding structures. One dam was studied near the lower end of the watershed below the Middle Branch junction and downstream from all planned structural measures. Lack of floodwater storage and local interest in other uses eliminated the site from consideration.

Objectives - cont'd

The sponsors recognize the value of conserving fish and wildlife resources consistent with proper use of soil and water resources. Their objective is to retain and enhance as much habitat as possible.

Environmental considerations

Modification of the previously selected works of improvement was required as a result of the National Environmental Policy Act in which Congress directed that "to the fullest extent possible, the policies, regulations, and public laws of the United States shall be interpreted and administered in accordance with policies set forth in the Act." The passing of this Act presented the need to review and give full environmental consideration to all watershed work planning.

Additional detailed survey data was obtained which indicated that channel work could be omitted in various reaches, thus minimizing disturbance to existing wildlife habitat. Destroyed habitat will be mitigated and enhanced through installation of vegetative treatment measures, management of forest land, protection of woody habitat and idle land within the permanent easement, planting of trees and shrubs, and grasses and legumes.

Soil erosion is considered minor; however, sheet erosion during high intensity rains results in delivery of sediment and soil fertility to streams and waterways. The progressive and on-going land treatment programs will control soil erosion on those acres adequately treated. This control will result in reduced sediment delivery to waterways, thereby reducing one source of water pollution.

Several acres within the floodway and flood plain receive floodwater damages, one to three times annually, resulting in reduced crop and pasture yields, and increased maintenance expenses for county roads and bridges. The selected plan will reduce flooding stages in Indiana on the more frequent floods. Flooding will continue to occur in Illinois at present stages.

Alternatives

1. Main channel and tributary improvements as proposed in the initial plan. This alternative would provide essentially the same drainage benefits as the planned project; flood benefits would be realized. There would be increased adverse environmental effects along main Jordan Creek downstream of the state line as a result of destruction of

Alternatives - cont'd

valuable woody habitat or fishery habitat. The installation costs would be $2,017,000. This alternative was eliminated when Illinois sponsors were unable to assure land rights for induced damage areas downstream of the project.

2. Installation of subsurface drainage pump system. The estimated construction cost is $1,047,800. This alternative is the installation of pumping stations where subsurface drainage is impaired. Basins would be constructed to serve as a collection point for the subsurface drain tiles. The pumps would then lift the water into existing drainageways. Discharge from pumps will be compatible with needed subsurface water removal.

   Periodic flooding would continue along those drainageways. Installation of this alternative would require only minor channel excavation, thus, nullifying most adverse effects on wildlife resources. The average annual cost of this alternative would be $244,880. Induced flooding would occur.

3. No PL-566 project--no local action. The on-going land treatment program will in time reduce sediment contribution to Jordan Creek and Little Creek; however, floodwater and drainage will continue to cause damages. The estimated net annual monetary benefits that would be foregone by not implementing the planned project are $385,137.

   Drainage and flooding relief have been a concern to the local people for nearly 30 years. It is likely they would attempt to obtain relief through minor channel work where determined needed and feasible. However, the local people are not required to give as full consideration to environmental criteria as the planned PL-566 project.

4. Land treatment only. An accelerated land treatment program will reduce erosion, thus sediment contribution to Jordan Creek and Little Creek. Properly selected and installed land treatment measures will slightly reduce runoff; however, the floodwater damages would remain nearly identical to present conditions. Drainage will remain unimproved and continue to cause damages as proper outlets would not be available. This alternative would have minimal adverse environmental effects on wildlife resources. The estimated net annual monetary benefits that would be foregone by not implementing the planned project are $399,400.

Alternatives - cont'd

5. Land treatment and nonstructural measures. The land treatment part of this alternative would be the same as the land-treatment-only alternative. The nonstructural measures to reduce flooding would be the conversion of approximately 230 acres of cropland that is now flooded annually to a less intensive agricultural use.

   This alternative would insignificantly reduce damages to agricultural land, and annual damages to county roads and bridges would continue. Minimal adverse environmental effects would result from this alternative.

6. General discussion. The proposed selected project is essentially a land treatment program. The project consists of the installation of planned conservation land treatment along with minor channel work where needed to obtain subsurface drainage outlets.

   Soil erosion is not a severe problem in the watershed. However, erosion control and reduced sedimentation will occur as a result of the land treatment program. Through establishing and maintaining needed conservation measures, most soil limitations will be overcome, resulting in more efficient production.

   A network of grassed waterways, surface drains and subsurface drains will provide drainage and flood reduction benefits. Local sponsorship for the Illinois portion of the watershed was not obtained, thus the selected plan does not provide floodwater control across the state line. Downstream flooding will continue to occur in Illinois at present stages.

   Many local landowners are interested in developing available recreational resources for public use. The available resources are concentrated along the lower reaches of Jordan Creek in Illinois. When Illinois failed to obtain local sponsorship, the available recreational resources for development were lost. No adequate resources are present in the Indiana portion of the watershed.

   Full environmental considerations were given to the selected plan. All adverse effects have been carefully studied with proper procedures taken to reduce their impact upon the total plan.

   The installation of this project will improve the quality of life and increase the demand of businesses within the area.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land treatment measures

An accelerated land treatment program will be installed on the watershed.

The land treatment measures to be installed during the eight year project installation period include conservation practices on 27,347 acres of cropland, 150 acres of pasture, 15 acres of forest land, and 5 acres of other land. Adequate treatment will be achieved on 27,517 acres covering 78 percent of the total watershed at the end of the installation period. This acreage is in addition to the 7,345 acres presently treated.

Conservation practices to be applied on cropland include contour farming, terraces, diversions, grassed waterways or outlets, minimum tillage, crop residue use, grade stabilization structures, subsurface drains, and drainage mains or laterals.[1/] A combination of two or more practices are often needed to achieve adequate treatment of land. Land treatment practices such as waterways, diversions, pasture planting and management, and tree planting will benefit wildlife. The Soil Conservation Service Technical Guide will be used in planning alternatives for adequate land treatment.

Pasture land treatment measures to be installed include pasture and hayland planting and pasture and hayland management.

Forest land treatment measures to be installed are tree planting on open lands where necessary to control erosion, and adjusting land use to land capability throughout the watershed. Adapted species for planting will be recommended by the Indiana Department of Natural Resources (IDNR) in cooperation with the U.S. Forest Service. Hydrologic conditions will be improved by manipulation of stand composition, protection from grazing and implementing management plans. The multiple-use forest land treatment program was cooperatively developed by IDNR, Division of Forestry and the U.S. Forest Service.

The sponsors estimate that 30 additional landowners or operators will become cooperators with the Soil and Water Conservation District and develop conservation plans during the project installation period.

At present, 25,000 acres of the watershed have been soil mapped. Plans are to map an additional 10,100 acres during the installation period.

1/ See Exhibit 1 for definition of practices.

Land treatment measures - cont'd

The SCS will provide the needed technical assistance for soil surveys, conservation planning, and application of conservation practices. Land treatment will consist of voluntary actions taken by individual landowners or operators.

Structural measures

The structural measures consist of approximately 12.2 miles of main channel work with 4.4 miles on Jordan Creek, 5.7 miles on Little Creek and 2.1 miles on Leak Ditch. Tributary structural measures consist of approximately 14.7 miles of new or reconstructed open ditches, 46.7 miles of surface drains, 5.1 miles of grassed waterway construction, 19.8 miles of tile in conjunction with surface drains and grassed waterways, and approximately 50 grade stabilization structures to provide controlled inlets for grassed waterways and surface drains into main channel and improved open ditches. 1/ Also, about 1.5 miles of debris removal on Jordan Creek main channel is included.

Main channels

Main channel work consists of channel enlargement and, where necessary, minor realignment. Construction on the Jordan Creek main channel starts near the center of Section 6, T22N, R9W, 1,800 feet downstream from a New York Central Railroad bridge and extends upstream to the junction of Jordan Creek and Leak Ditch located in the northwest quarter of Section 32, T23N, R9W. The work commences again on Jordan Creek main channel in the northeast quarter of Section 17, T23N, R9W, 1,150 feet upstream from a county road bridge and continues upstream to State Road 26. Little Creek construction extends from a county bridge on the west line of Section 7, T22N, R9W upstream to the center of Section 22, T22N, R9W. Leak Ditch construction will start west of Tab at a county road bridge located near the center of Section 30, T23N, R9W and continues upstream 5,600 feet to a county road bridge located on the west line of the southwest quarter of Section 19, T23N, R9W. Construction starts again 1,470 feet upstream from a county road bridge and is located approximately 1,000 feet east of the center of Section 18, T23N, R9W. Construction continues upstream to Indiana State Road 26.

1/ The term "surface drains" is an accepted local term which includes SCS specifications for Drainage Mains or Laterals (480) Open Channel (582).

Structural measures - cont'd

The main channel improvements traverse primarily through glacial till in Reaches A, B, and D. Through Reaches C and E the glacial till is present in exposed banks of the channel, but is covered with glacial outwash in the valley which contains lenses of silts, clays, and gravels. Armor plating will be used to protect those soils encountered that are erosive or unstable due to the velocities within the channel.

Main channel design discharges were furnished by the planning hydrologist for Jordan Creek main through Reaches C and E, and for Leak Ditch and Little Creek through the lower parts of Reaches A and D, respectively. Design discharges for the remaining portions of the project are based on good agricultural drainage and the flood control provided by a 1-year cropping season level of protection. Less intense use of the rather narrow flood plain downstream from construction dictated less protection and, finally, termination of channel work.

The channel work will deepen the existing channel for drainage and also widen it where additional capacity is required. Channel work is planned to follow existing alignment. Excavation will be done from one side to reduce damage to wildlife habitat (Exhibit 4). Significant trees will be left standing on the constructed side, if at all practicable, during operations. In isolated cases where slope protection is required on the opposite bank, work may be done from both sides. All flow impeding brush and unstable or fallen trees will be removed from both banks. Removal will be carried out from the side designated for spoil. Armor plating (gravel blanket) will be used to protect unstable soils on the bottom and sides of the channel. The berm will be used as a maintenance travelway. A 15-foot vegetated buffer strip will be maintained on the unconstructed side to protect the channel from farming operations and also serve as a travel lane for wildlife.

Fences will be installed to protect vegetative cover where there is a potential for livestock use of the area adjacent to the channel. Markers will be used to delineate the boundaries of wildlife plantings and vegetative buffer strips (Exhibit 4). Openings will be left in the spoil to avoid induced stages on the unconstructed side. Appurtenances are planned for all reaches to safely lower surface water into channels. All existing tile outlets disturbed by construction will be replaced.

Inadequate tile outlets to Jordan Creek will be corrected by reconstruction of the tile line or by other means to provide a "free" outlet for existing tile.

Structural measures - cont'd

Work, as necessary, will take place on the unconstructed side to install appurtenances. Appurtenances on Little Creek include the construction of a multi-plate pipe arch approximately 96" x 159" to replace a county road bridge located on the north line of Section 20, T22N, R9W. The purpose of installing the pipe arch is 50 percent flood control and 50 percent drainage with flood control benefits being the elimination of induced flooding downstream of the road bridge. Care will be taken to minimize the disturbance of wildlife habitat.

The 1.5 miles of minor debris removal on Jordan Creek main channel runs from a point approximately 0.8 miles upstream of the Indiana-Illinois state line to the junction of Jordan Creek main channel and Little Creek, a distance of about 1.5 miles. The work involves mostly the removal of one log jam and the work will not affect the stability of the channel. The work will be done so as to minimize the disturbance of wildlife habitat. The interdisciplinary team will be consulted where debris removal is anticipated.

Care will be exercised to minimize the amount of construction sediment. As a minimum, at least one trap will be used per mile of channel construction. The minimum size of the sediment trap will be 100 feet long and three feet deep (below channel bottom grade). Cleared material will be buried or disposed of by other acceptable means.

Archaeological sites identified during the archaeological reconnaissance survey of this project will be dealt with in accordance with the Archaeological and Historical Preservation Act (Public Law 93-291).

Access routes for construction equipment will be routed around the small knoll areas. Any sites which lie within the easement area along the channel will not be leveled.

Land rights on main and tributary channels will consist of approximately 194 acres of permanent easements and approximately 455 acres of temporary easements. The permanent easement area will consist of approximately 69 acres of other land,1/ 48 acres of woody vegetation, and 69 acres of cropland. The temporary easement area is in cropland. These areas will not be available to the public without the permission of the landowner.

Woody vegetation will be established and maintained within the permanent easement area on approximately 27 acres to mitigate woody wildlife habitat destroyed by the structural improvements. A strip of trees and shrubs approximately 10 feet in width will be planted

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1/ Other land includes - channel bottom and side slopes and areas providing wildlife habitat adjacent to the channel.

Structural measures - cont'd

within the permanent easement on the spoil area. The vegetated buffer strip on the unconstructed side of the channel, within the permanent easement, includes existing woody material that can be utilized for wildlife habitat. Approximately 56 acres of grasses and legumes will be seeded on the disturbed areas within the permanent easement on the main channel.

Condensed profiles of the planned channel work are attached as Exhibit 6.

A variety of materials will be encountered during construction. A general description of materials, by reach, is tabulated below:

JORDAN CREEK

Reach B

101+00 to 235+00 -- Predominantly glacial till silty clay (CL) overlain by thin weathered till (ML or CL). Plasticity indices estimated to range between 10 and 20.

Reach C

410+86 to 508+00 -- Predominantly glacial till silty clay and silt (CL and ML) overlain by silt (ML) and clayey silts (ML or CL) with plasticity indices ranging between 10 and 20. Sands, gravel, silty sand and sandy silt near bottom in some areas (SC, ML, SM).

LEAK DITCH

Reach A

8+00 to 65+00 -- Predominantly silty and sandy clay glacial till with estimated plasticity indices ranging from 10 to 20.

170+12 to 226+22 -- Three to five feet of surficial glacial till (CL) with estimated plasticity indices of 10 to 20, overlying loose wet sand and clayey sand (SC, CL and SP).

LITTLE CREEK

Reach D

23+60 to 225+00 -- Predominantly glacial till; 3-6 feet of firm, dense sandy and silty clay (CL) overlying wet, soft sand, silt and clay (SM, SC, ML, and CL), in turn overlying firm, moist, sandy clay (CL).

225+00 to 323+24 -- Sandy clay and silty clay (CL) overlying soft wet sandy clays and sandy silts (ML, CL, SM, and SC).

WORKS OF IMPROVEMENT TO BE INSTALLED

Tributary structural measures

The tributary open ditch work will deepen (reconstruct) and construct (new) about 14.7 miles of channel. The open drains will be located as shown on the project map, Exhibit 12. The work will be to provide surface and subsurface drainage outlets. The open drains will have a bottom width of 4 feet, 2:1 or flatter side slopes, and shaped spoil banks. In areas where wildlife habitat exists, construction will be in accordance with Exhibit 4. A picture of a typical open drain is shown in Exhibit 2.

The tributary work also includes approximately 46.7 miles of surface drains. Those with drainage areas less than 640 acres will be constructed in accordance with SCS specifications for Drainage Mains or Laterals (480) and those with drainage areas greater than 640 acres will be constructed in accordance with SCS specifications for Open Channels (582). The bottom width will vary from 8 feet and larger. Side slopes will be 4:1 or flatter and depths will vary from 1 foot to about 3 feet. The purpose of the surface drains is to remove surface water that otherwise would pond and cause crop damage. A picture of a typical surface drain is shown in Exhibit 2. The surface drains will be located as shown in the project map, Exhibit 12.

Five and one-tenth miles of grassed waterways will be constructed in locations as shown on the project map, Exhibit 12. The grassed waterways will be constructed in accordance with SCS specification 412. The cross sections will be parabolic with depths of 1 to 3 feet.

About 19.8 miles of tile with a diameter of 8 inches and larger will be installed in locations as shown in Exhibit 12. The tile will be installed in accordance with SCS specification 606. A typical tile installation is shown in Exhibit 2.

EXPLANATION OF INSTALLATION COSTS

The costs of installing the land treatment measures are summarized in Table 1. Estimated total cost for technical assistance is $60,440, of which $60,240 will be paid from Soil Conservation Service funds (PL-566--$18,640) and $200 from Forest Service funds. Landowners and operators will spend an estimated $693,840 for measures installed on their lands.

The estimated schedule of PL-566 and other obligations for installation for the land treatment is indicated as follows:

Fiscal Year	Technical Assistance PL-566	Technical Assistance Other	Installation Cost Landowners and Operators
1st	$ 2,330	$ 5,225	$ 86,730
2nd	2,330	5,225	86,730
3rd	2,330	5,225	86,730
4th	2,330	5,225	86,730
5th	2,330	5,225	86,730
6th	2,330	5,225	86,730
7th	2,330	5,225	86,730
8th	2,330	5,225	86,730
Total	$18,640	$41,800	$693,840

Structural measures

Installation costs for structural measures as shown in Table 2 include construction, land rights, engineering, and project administration costs. The table shows the total PL-566 and Other costs.

Construction costs are the estimated contract cost for constructing structural measures. It includes all materials, labor, and machinery involved in construction (including mitigation measures). A contingency is added to the estimated contract cost for all works of improvement to defray any unexpected cost that may occur during construction. Also a special 10 percent allowance was added to all main channel works to cover possible stability work during the establishment period.

Engineering costs are the costs for preparing construction plans for the structural measures. These costs include the direct cost of engineers, geologists, and technicians for construction surveys and investigations; soil and foundation drilling and testing; and design and preparation of construction plans and specifications.

Land rights costs include all expenditures for: (1) acquisition of land rights for construction and mitigation, the value of which is estimated by the sponsoring local organizations; (2) relocation or reconstruction of property line fences; (3) relocation, alteration, or removal of pipelines and/or utility lines; (4) all legal fees and surveys associated with acquisition of land rights. Land required for channel work includes a

Structural measures - cont'd

permanent easement on that land between the outside edge of the buffer strip on the unconstructed side and the crest of the spoil bank on the constructed side. An area 15 feet from the ditch slope on the unconstructed side is required (when one side construction is used).

Project administration costs are the PL-566 and Other administration costs associated with the installation of the works of improvement. Project administration costs include the cost of contract administration which is borne by Other funds. Also included in project administration costs are government representative services and necessary inspection service during construction to insure that structural measures are installed in accordance with the construction plans and specifications. These latter expenses are paid by PL-566 funds.

Cost allocation and cost sharing

Costs for all planned channel improvement, surface drains, and grassed waterways are allocated 50 percent to flood prevention and 50 percent to drainage. Costs for tile are allocated 100 percent to drainage. Cost allocation procedures and methods are covered fully under ECONOMICS in the Investigations and Analyses section of this plan.

One-hundred percent of construction and mitigation costs allocated to flood prevention and 50 percent of the construction and mitigation costs allocated to drainage are PL-566 costs. All engineering costs will be 100 percent PL-566 funds. All land rights costs will be paid by Other funds.

The construction of protective fencing, multi-plate pipe arch, armor plating, boundary markers, and wildlife plantings are considered construction costs and cost sharing for these items will be the same as for other construction items for that particular channel reach.

Project costs

All works of improvement in Reaches A, B, C, D, E, and J are located in Indiana. Certain surface drains and grassed waterways include associated tile main installations.

A summary of the estimated installation costs in Indiana are shown in the following table:

Structural measures - cont'd

Project costs

	PL-566	Jordan Creek Conservancy District	Total
Construction	$ 822,320	$310,680	$1,133,000
Engineering Services	113,600	--	113,600
Land Rights	--	267,000	267,000
Project Administration	226,600	33,990	260,590
TOTAL	$1,162,520	$611,670	$1,774,190

An estimated schedule of PL-566 and Other obligations for installation of the structural measures by fiscal year (including project administration cost) is tabulated in dollars as follows:

FY[1/]	PL-566	Jordan Creek Conservancy District
1st	$ 31,365	$ 17,600
2nd	458,290	238,300
3rd	421,745	213,940
4th	251,120	141,830
Total	$1,162,520	$611,670

Non-Project costs

There are no known or anticipated non-project costs for this project. Should any non-project costs occur, they must be borne by the sponsoring local organizations. This subject is covered here to avoid possible misunderstanding during contract negotiations and construction.

Non-project costs include all additional costs resulting from changes of, or additions to, project works of improvement for non-project purposes or maintenance such as 1) distributing and leveling spoil or disposing of excavated material primarily to improve land; 2) filling depressional areas outside of the right-of-way; or 3) modifying planned works of improvement for the convenience of the sponsoring local organizations.

1/ The first 4 years of an 8-year installation period.

EFFECTS OF WORKS OF IMPROVEMENT

Conservation land treatment

The application of land treatment measures will bring an additional 27,517 acres under adequate treatment. Conservation practices to be applied to cropland are contour farming, grassed waterways, grade stabilization structure, conservation cropping systems, crop residue management, terraces, and minimum tillage. These practices will reduce erosion through interception of rainfall, reduction of runoff and stabilization of drainageways. Reducing sheet erosion will permit inherent and applied fertility to be maintained. The use of conservation cropping systems, including minimum tillage will provide improved plant growth through improvement of soil characteristics. The combined effects of these practices will reduce the annual soil loss of the 8,400 acres of erosive cropland from 5.7 tons/acre to 2.5 tons/acre. This rate of soil loss is within the 3.5 tons/acre annual soil loss tolerance. The application of soil and water conservation practices will reduce soil loss from erosion, promote the proper use of soil and water resources and provide lower maintenance costs for the planned structural measures.

These conservation practices will reduce the sediment yield from the watershed from an estimated 12,000 tons annually (.33 tons per acre) to about 9,000 tons annually (.21 tons per acre).

Removal of surplus water through installation of subsurface drains, drainage field ditches, and drainage mains or laterals will enhance growth on 26,800 acres of cropland with a wetness limitation. Reduced production costs, improved crop quality, and increased yields will increase the efficiency for the farm enterprise.

Pasture management practices to be applied on 150 acres will improve the overall quality and productivity of pasture areas. Soil erosion will be reduced from .22 tons/acre to .13 tons/acre. Such areas, when properly treated and managed, complement the overall farm operation, contributing significantly to farm income with a minimum of erosion.

Forest land treatment measures to be applied to 15 acres will improve the overall hydrologic condition of the watershed. Creation of a good humus layer in these areas will reduce runoff and erosion. Approved cultural operations and livestock exclusion from forest land will improve the quality of future forest land production as well as increase the overall quantity of production.

The average annual soil loss from the watershed will be reduced from an estimated 49,172 tons/year to 28,098 tons/year.

Conservation land treatment - cont'd

Many species of wildlife will benefit from vegetative land treatment measures that contribute to the quality of wildlife habitat. Some of these measures are: grassed waterways, diversions, pasture and tree planting, critical area planting and protection from grazing.1/

Some land use change is projected to occur during the life of this project; however, these changes are expected to result from changing economic and technological conditions rather than project action.

Structural measures

Greatest impact of planned channel improvement will be in relieving joint floodwater-drainage problems occurring throughout watershed Reaches A, B, C, D, E, and J. An estimated 15,920 acres in total will benefit from the project.

Benefits will accrue through the removal of surplus surface and subsurface water. Many existing tile drains, currently inoperative because of poor outlet conditions, will become operational. Farming operations delayed in the past because of water problems will be permitted to proceed on a timely basis. Yields will increase and production costs decrease. Opportunities to capitalize on the production advantages afforded by an increasing level of technology will be increased.

In addition, many areas of the watershed affected by joint floodwater drainage problems, but not dependent on the project for their solution, will benefit through a demonstration effect. Structural measures installed as a part of the project will clearly serve as impetus to these areas for installation of the most practical combination of needed on-farm drainage improvements.

Areas on which damage-reduction benefits were evaluated include the flood plain described under "Watershed Problems." Crop and pasture damages will be reduced by 40 percent, damage to roads and bridges 14 percent, and indirect damages 29 percent in these areas.

An estimated 155 agricultural landowners and several roads and bridges will be benefited. Benefits will accrue through increased agricultural

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1/ Reference - Soil Conservation Service Biology Technical Note No. 6 Wildlife Response to Selected Conservation Practices.

Structural measures - cont'd

production, reduced crop and pasture production costs, and lower maintenance expenses on flood plain improvement. Principal beneficial effects will result from reduced stages on the more frequent floods (floods expected to occur once every 5 years or more often). A summary comparison of flooded areas with and without the project for the area on which damage-reduction benefits were evaluated in Indiana is presented below:

(Flood)	(Without Project)	(With Project)
100-year	1881 ac.	1774 ac.
5-year	1069 ac.	721 ac.
1-year	514 ac.	294 ac.

Protection from the 1-year cropping season flood will be afforded by the project on Reaches A, B, C, D, and J.

No increase in stages will occur on the Illinois portion of Jordan Creek downstream of the area on which flood reduction benefits were evaluated. A summary of flooded areas with and without the project in Illinois is presented below:

(Flood)	(Without Project)	(With Project)
100-year	478 ac.	476 ac.
5-year	376 ac.	364 ac.
1-year	300 ac.	300 ac.

The method of installation of structural measures is proposed so that the minimum possible wildlife habitat destruction will occur. About 22 acres of woody wildlife habitat will be destroyed during construction. The wildlife habitat losses will be mitigated by replanting trees and shrubs on the spoil area, securing a permanent easement on existing trees and shrubs as a "filter strip" on the unconstructed side of the channel. Based on recommendations of members of the fish and wildlife discipline, about 27 acres of trees and shrubs will be replanted. All disturbed areas within the permanent easement will be seeded with a grass and legume mixture to provide herbaceous cover for wildlife and to prevent erosion. The existing stream has some fishery value as a spawning stream up to the vicinity of Little Creek tributary. This value will not be disturbed by the installation of the works.

Structural measures - cont'd

The proposed design of structural measures and method of construction will reduce soil erosion within the channel, and provide for better bank stability. Sediment traps at selected intervals will reduce sediment movement downstream during construction activity.

Economic and social

During the period of construction, approximately 39 man-years of labor will be required for the installation. During the life of the project, about 8 man-years will be required annually for the operations and maintenance of structural and associated land treatment measures.

The quality of living for the beneficiaries of the project should be improved because of the benefits realized from the project. The average benefits for 130 farm units will be approximately $3,820.

Secondary effects generated by the project will be through increased demands on local suppliers of goods and services and on local processing, transporting, and marketing facilities.

PROJECT BENEFITS

Total average annual benefits to project structural measures are estimated at $496,060 (Table 6).

Primary benefits to structural measures were estimated as follows: damage reduction - $11,840; more intensive land use - $138,500; and drainage - $138,500 (Table 6).

Local secondary benefits to structural measures were estimated at $207,220 (Table 6).

Only those secondary benefits generated by the project through increased demands on local suppliers of goods and services and on local processing, transporting, and marketing facilities were evaluated. Benefits accruing through an enhancement of the overall environment of the watershed area, although significant locally, were not evaluated. Benefits of a secondary nature from a national viewpoint were not considered pertinent and were, therefore, not evaluated.

COMPARISON OF BENEFITS AND COST

Average annual costs, benefits, and comparison of benefits and costs are shown in Tables 4 and 6. The ratio of average annual benefits, excluding secondary benefits, of $207,220 to average annual cost of $120,420 is 2.4:1.0. The ratio of benefits to costs is $496,060 to $120,420 or 4.1:1.0.

PROJECT INSTALLATION

Land treatment measures

The Warren County Soil and Water Conservation District will assume the responsibility for the application of the land treatment measures. The measures will be installed by private landowners and operators within an 8-year period. The SCS will provide personnel to assist the District in providing landowners and operators technical assistance to develop conservation plans and to install planned practices. Technical assistance for the forest land measures will be furnished by the IDNR Division of Forestry in cooperation with the U.S. Forest Service.

Structural measures

All works of improvement will be installed during a 4-year period. Construction plans and specifications on contracts will be completed after the land rights are secured. Mitigation measures are considered construction costs and will be a part of each construction contract. In order to make efficient use of personnel and to realize the most benefit from the structural measures, the works of improvement will be installed in the following yearly sequence:

1. Lateral Improvement - Reach J

2. Jordan Creek Main - Reach E, Reach C, and Reach B
   Lateral Improvements - Reach C and Reach B

3. Jordan Creek Main - Reach D
   Lateral Improvement - Reach D

4. Little Creek Main - Reach A
   Lateral Improvements - Reach A and Reach E

The Jordan Creek Conservancy District is the sponsoring local organization qualified under state law to carry out works of improvement outlined in the plan. The Conservancy District has the powers of eminent domain and taxation, as provided by the Indiana Conservancy Act, and will use these powers as necessary to assure scheduled completion of the project. The Conservancy District will be responsible for securing land rights and administering contracts for all works of improvement in Indiana. The Conservancy District will be responsible for 50 percent of construction costs allocated to drainage within Indiana.

The Soil Conservation Service, under authority of PL-566, will be responsible for all phases of installation of works of improvement, including engineering services, except for acquisition of land rights and contracting for construction. The Service will be responsible for all construction costs allocated to flood prevention and 50 percent of construction costs allocated to drainage.

Structural measures - cont'd

The Indiana Department of Natural Resources, in accordance with state laws and regulations, will review and approve plans and specifications for structural works of improvement to be constructed in Indiana.

The Jordan Creek Conservancy District will administer contracts for structural measures in Reaches A, B, C, D, E, and J. In addition, it will be accountable for managing finances associated with installing those measures which involve the expenditure of PL-566 funds. This will require development of a financial management system which shall provide for the maintenance of appropriate records, reports, audits, and accounts needed to satisfy the requirements of OMB Circular A-102.

An interdisciplinary team comprised of representatives from the Indiana Department of Natural Resources, U.S. Fish and Wildlife Service, landowners and sponsors, and the SCS will participate in the development of design plans and specifications and operation and maintenance procedures. These cooperatively developed plans and specifications will be adhered to unless determined inappropriate during construction; however, all members of the team will be provided the opportunity to develop the necessary revisions.

FINANCING PROJECT INSTALLATION

Federal financial assistance for carrying out the works of improvement set forth in this plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (PL-566, 83rd Congress, 68 Stat. 666), as amended. Federal financial assistance is contingent on the appropriation of funds to carry out this plan.

Land treatment measures

Technical assistance for installation of all accelerated land treatment for which the Soil Conservation Service has responsibility will be provide with PL-566 funds. Technical assistance for forest land treatment measures will be provided by the IDNR, Division of Forestry in cooperation with the U.S. Forest Service through the Cooperative Forest Management Program.

Any cost-sharing for installation of approved land treatment measures will be provided through the Agricultural Conservation Program (ACP), administered by the Agricultural Stabilization and Conservation Service, or by other funds as might be appropriated by Congress.

Structural measures

The Jordan Creek Conservancy District in Indiana has been organized since 1969. It has levied a general tax over the watershed within the state during the interim planning period.

It has carried out the necessary organizational activities during this period. In consideration of its financial needs during operations, a letter of intent has been filed with the Farmers Home Administration for an FHA loan.

The sponsor has engaged legal counsel and is prepared to act as the contracting organization in its District.

The Jordan Creek Conservancy District is responsible for the following installation costs:

1. 100 percent of the land rights, Est. $267,000;
2. 50 percent of tile cost and 25 percent of all other construction costs, Est. $310,680;
3. Project administration costs, Est. $33,990.

Invitations to bid on the construction of planned structural measures will be issued after the project agreements are executed. These agreements will be administered when the following conditions have been met: 1) PL-566 funds have been appropriated; 2) the sponsor has funds available and is prepared to fulfill its responsibilities; 3) necessary land rights for construction and mitigation have been obtained; 4) construction plans and specifications have been prepared and approved as required; and 5) operation and maintenance agreements and plans have been executed.

Structural measures - cont'd

In accordance with OMB Circular A-102, the Jordan Creek Conservancy District will account to the Service certain earned income during the grant period.

For this purpose, the grant period shall extend from the effective date of the Service's fund obligating agreement until the date on which the Service formally notifies the sponsors that the undertaking has been satisfactorily completed.

Program income may include, but is not limited to, income from service fees, usage, or rental fees and sale of assets purchased with federal funds under a Service-fund agreement.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures

The land treatment measures will be operated and maintained by the owners and operators of farms under agreement with the Warren County Soil and Water Conservation District. Technical assistance will be provided by the Soil Conservation Service.

Forest land treatment measures will be maintained by the landowners with technical assistance furnished by the Indiana Department of Natural Resources in cooperation with the U.S. Forest Service under the on-going Cooperative Forestry Program.

Structural measures

Operation and maintenance costs include all necessary expenditures after installation to realize the estimated benefits during the project evaluation period.

The sponsoring local organization will assume responsibility for operation and maintenance of all measures including measures for fish and wildlife. The operation and maintenance work will consist of such items as spraying or controlling of adverse vegetative growth within the channel and on channel side slopes, removing debris and/or excavation of shoal deposits as required to reduce serious bank erosion, maintaining channel capacity, repairing of critical areas by seeding, sodding or placement of riprap, and protection of project mitigation features within the permanent easement areas. Operating agreements will include provisions as indicated in the revegetation plan. Operation and maintenance activities will be conducted in a manner to minimize adverse environmental effects. State and federal agency restrictions on pesticides will be recognized when providing maintenance on project rights-of-way.

The Jordan Creek Conservancy District will be responsible for the operation and maintenance of the structural works of improvement installed. It has the authority to finance this work by either taxation or special assessment. The District shall budget annually the necessary funds to meet the probable expenses of operation and maintenance plus 10 percent to meet contingencies.

Annual operation and maintenance cost for works of improvement is estimated to be $15,850.

A period of time is prescribed to provide for the establishment of adequate vegetative cover for channels. This "establishment period" shall extend for up to 3 years from the date the structural works

Structural measures - cont'd

of improvement are accepted from the contractor as being completed. The establishment period is to terminate when any of the following conditions are met:

a. Adequate vegetative cover is obtained;
b. Two growing seasons have elapsed after the initial installation of vegetative work;
c. Three years after completion of works of improvement.

The Soil Conservation Service and the local sponsors have agreed to accept some minor deviation in the design criteria of some channels recognizing a degree of risk is involved in establishing their stability. Additional work may be necessary during the establishment period to achieve the desired stability.

During the establishment period for vegetative measures, SCS may approve PL-566 cost-sharing for additional work required to obtain an adequate vegetative cover. Approval of SCS is also required for PL-566 cost-sharing for other repair or additional work on completed structural works of improvement. Requests for approval will be considered if:

a. The need is determined during the establishment period;
b. The need results from latent conditions unknown to both SCS and the sponsor;
c. PL-566 cost-sharing requested for the repair of additional work does not exceed the ratio authorized for the original construction of the specific work involved; and
d. Performance of the repair or additional work does not lessen or adversely affect the legal liability of the construction contractor or his surety to bear the cost of the work.

A Soil Conservation Service representative will make a joint inspection with the sponsors annually; after severe floods and after the occurrence of any unusual conditions that might adversely affect the structural measures. These joint inspections will continue for 3 years following the acceptance of the works of improvement for operation and maintenance by the local sponsors. Inspections after the third year will be made annually by the sponsors. A report will be prepared of any such inspections making sure that the Service representative receives a copy. The Indiana Department of Natural Resources will be informed of any scheduled inspections. A record of each inspection will be kept in the sponsor's file and will be available for authorized inspection.

Specific operation and maintenance agreements and plans will be executed between the sponsors and the Soil Conservation Service prior to signing

Structural measures - cont'd

land rights, relocation or project agreements. These agreements will use as a basis the SCS State Watershed Operations and Maintenance Handbook. These agreements will contain, in addition to specific sponsor responsibilities for nonstructural and structural measures, specific provisions of OMB Circular A-102 for retention and disposal of real and personal property acquired in whole or in part with PL-566 funds.

TABLE 1 - ESTIMATED PROJECT INSTALLATION

Jordan Creek Watershed, Indiana

INSTALLATION COST ITEM	Unit	Number		Estimated Cost (Dollars) 1/				
		Non-Fed. Land	Total	PL-566 Funds Non-Federal Land SCS	Other Non-Federal Land SCS 4/	Other FS 4/	Other Total	Total
LAND TREATMENT								
Land Areas 2/								
Cropland	Ac.	27,347	27,347		679,320		679,320	679,320
Grassland	Ac.	150	150		7,800		7,800	7,800
Forest Land	Ac.	15	15			470	470	470
Other Land	Ac.	5	5		6,250		6,250	6,250
Technical Assistance				18,640	41,600	200	41,800	60,440
TOTAL LAND TREATMENT		27,517	27,517	18,640	734,970	670	735,640	754,280
STRUCTURAL MEASURES								
Construction								
Channel Modification 3/								
(M)	Mi.	22.3	22.3	605,860	201,960		201,960	807,820
(0)	Mi.	4.6	4.6	27,000	9,000		9,000	36,000
Surface Drains and Grassed Waterways	Mi.	51.8	51.8	134,610	44,870		44,870	179,480
SP Main Tile Installation	Mi.	19.8	19.8	54,850	54,850		54,850	109,700
Subtotal - Construction				822,320	310,680		310,680	1,133,000
Engineering Services				113,600				113,600
Subtotal - Engineering								
Project Administration				90,640				90,640
Construction Inspection				135,960	33,990		33,990	169,950
Other Cost				226,600	33,990		33,990	260,590
Subtotal - Project Adm.								
Other Costs					267,000		267,000	267,000
Land Rights					267,000		267,000	267,000
Subtotal - Other								
TOTAL STRUCTURAL MEASURES				1,162,520	611,670		611,670	1,774,190
TOTAL PROJECT				1,181,160	1,346,640	670	1,347,310	2,528,470

1/ Price Base: 1974
2/ Includes only areas estimated to be adequately treated during the project installation period. Treatment will be accelerated throughout the watershed, and dollar amounts applied to total land areas, not just to adequately treated areas.
3/ Type of channel prior to project: (M) - manmade ditch or previously modified channel; (0) - none or practically no defined channel.
4/ Federal agency responsible for assisting in installation of works of improvement.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

(At Time of Work Plan Preparation)

Jordan Creek Watershed
Indiana

Measures	Unit	Applied to Date	Total Cost (Dollars 1/)
Land Treatment			
Basic Conservation Plans	No.	58	---
Conservation Cropping System	Ac.	10,130	50,650
Contour Farming	Ac.	398	1,194
Critical Area Planting	Ac.	---	---
Crop Residue Use	Ac.	7,250	21,750
District Cooperators	No.	123	---
Drainage Field Ditch	Ft.	5,000	3,500
Drainage Main or Lateral	Ft.	4,000	6,000
Grade Stabil. Structure	No.	21	25,200
Grassed Waterway or Outlet	Ac.	30	12,000
Minimum Tillage	Ac.	8,500	25,500
Pasture and Hayland Mgt.	Ac.	260	7,800
Pasture and Hayland Planting	Ac.	---	---
Pond	No.	---	---
Standard Soil Survey	Ac.	25,000	6,500
Subsurface Drain	Ft.	2,030,000	1,624,000
Tree Planting	Ac.	10	350
Wildlife Upland Habitat Mgt.	Ac.	35	1,750
Total	XXX	XXXXXXXXX	1,786,194

1/ Price Base: 1974

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TABLE 2--ESTIMATED STRUCTURAL COST DISTRIBUTION

Jordan Creek Watershed, Indiana
(Dollars) 1/

Item 2/	Installation Cost PL-566 Funds			Installation Cost--Other Funds			Total Installation Cost
	Construction 3/	Engineering	Total PL-566	Construction 3/ 4/	Land Rights	Total Other	
5/ MP--Reach A; Leak Ditch	58,275	7,770	66,045	19,425	12,800	32,225	98,270
MP--Lat. Improvements	43,800	5,840	49,640	14,600	19,590	34,190	83,830
SP--Lat. Improvements	4,450	890	5,340	4,450	--	4,450	9,790
MP--Reach B; Main	62,525	8,340	70,865	20,845	14,050	34,895	105,760
MP--Lat. Improvements	135,375	18,050	153,425	45,125	56,980	102,105	255,530
SP--Lat. Improvements	9,500	1,900	11,400	9,500	--	9,500	20,900
MP--Reach C; Main	51,765	6,900	58,665	17,255	14,830	32,085	90,750
MP--Lat. Improvements	61,725	8,230	69,955	20,575	23,030	43,605	113,560
SP--Lat. Improvements	2,250	450	2,700	2,250	--	2,250	4,950
MP--Reach D; Little Cr.	120,080	16,010	136,090	40,030	27,000	67,030	203,120
MP--Lat. Improvements	153,375	20,450	173,825	51,125	59,240	110,365	284,190
SP--Lat. Improvements	24,650	4,930	29,580	24,650	--	24,650	54,230
MP--Reach E; Main	1,500	500	2,000	500	100	600	2,600
MP--Lat. Improvements	56,775	7,570	64,345	18,925	30,190	49,115	113,460
SP--Lat. Improvements	14,000	2,800	16,800	14,000	--	14,000	30,800
MP--Reach J; Lat. Improvements	22,275	2,970	25,245	7,425	9,190	16,615	41,860
Subtotal	822,320	113,600	935,920	310,680	267,000	577,680	1,513,600
Project Administration	XXXXXXX	XXXXXXX	226,600	XXXXXXX	XXXXXXX	33,990	260,590
GRAND TOTAL	XXXXXXX	XXXXXXX	1,162,520	XXXXXXX	XXXXXXX	611,670	1,774,190

1/ Price Base: 1974.
2/ See Table 3A for type of channel that existed before the project.
3/ Mitigation costs for construction to PL-566 $15,000 and to Other $5,000.
4/ All lateral improvement construction costs include 50% of tile cost where applicable.
5/ Purpose: MP--Multiple Purpose; SP--Single Purpose.

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Jordan Creek Watershed, Indiana
(Dollars)1/

	COST ALLOCATION			COST SHARING					
	PURPOSE			PL-566			OTHER		
	Flood Prevention	Drainage	Total	Flood Prevention	Drainage	Total	Flood Prevention	Drainage	Total
Reach A-Leak	49,135	49,135	98,270	42,735	23,310	66,045	6,400	25,825	32,225
Ditch Lat. Imp.	41,915	51,705	93,620	32,120	22,860	54,980	9,795	28,845	38,640
Reach B-Main	52,880	52,880	105,760	45,855	25,010	70,865	2,025	27,870	34,895
Lat. Imp.	127,765	148,665	276,430	99,275	65,550	164,825	28,490	83,115	111,605
Reach C-Main	45,375	45,375	90,750	37,960	20,705	58,665	7,415	24,670	32,085
Lat. Imp.	56,780	61,730	118,510	45,265	27,390	72,655	11,515	34,340	45,855
Reach D-Little	101,560	101,560	203,120	88,060	48,030	136,090	13,500	53,530	67,030
Crk. Lat. Imp.	142,095	196,325	338,420	112,475	90,930	203,405	29,620	105,395	135,015
Reach E-Main	1,300	1,300	2,600	1,250	750	2,000	50	550	600
Lat. Imp.	56,730	87,530	144,260	41,635	39,510	81,145	15,095	48,020	63,115
Reach J - Lat. Imp.	20,930	20,930	41,860	16,335	8,910	25,245	4,595	12,020	16,615
GRAND TOTAL	696,465	817,135	1,513,600	562,965	372,955	935,920	133,500	444,180	577,680

1/ Price base 1974

Date: October 1975

TABLE 3 - STRUCTURAL DATA
(Main Channels)
Jordan Creek Watershed, Indiana

Channel Name and Reach	Station		Drainage Area Sq. Mi.	Required Capacity cfs.	Channel Dimensions 1/ Bottom Width	Bottom Grade	Depth 2/ of Flow	"n" Value Aged	"n" Value As Built	Velocities ft./sec. Aged	Velocities ft./sec. As Built	Excavation Cu.-Yds.	3/ Purpose	Before Project Type of Channel 4/	Before Project Flow Condition 5/
Jordan Creek Reach B	101+00	235+00	5.5	160	4	.0021	4.0	.040	.028	2.9	3.7	13,000	MP	M	I
	235+00	410+86	16.0	400		NO	WORK								
Jordan Creek Reach C	410+86	508+00	28.0	640	20	.00074	5.7	.030	.025	3.3	3.8	14,000	MP	M	Pr
	508+00	578+08	28.4			NO	WORK								
Jordan Creek Reach E	578+08	668+00	51.0	1050	DEBRIS REMOVAL							-0-	MP	M	Pr
Leak Ditch Reach A	8+00	35+70	1.5	55	4	.0044	2.1	.040	.028	2.9	3.7		MP	M	I
	35+70	65+00	2.6	86	4	.0021	3.0	.040	.028	2.4	3.2		MP	M	I
	65+00	170+12	4.3	130		NO	WORK								
	170+12	226+22	7.1	200	8	.0007	4.6	.035	.028	2.2	2.6	12,000	MP	M	I
	226+22	285+00	7.1	200		NO	WORK								
Little Creek Reach D	23+60	125+90	5.6	160	4	.00066	5.1	.040	.028	1.9	2.4		MP	M	I
	125+90	225+00	10.0	270	6	.00066	5.3	.040	.028	2.1	2.8		MP	M	I
	225+00	323+24	15.0	375	10	.0007	5.9	.035	.028	2.6	3.0	30,000	MP	M	I
	323+24	358+00	16.3	410		NO	WORK								

1/ Side slopes on constructed side are 3:1 and on unconstructed side are approximately 2:1.

2/ Depths shown are normal depths for the capacity required.

3/ Purpose: MP-Multiple Purpose

4/ (M)-Manmade ditch or previously modified channel.

5/ I-Intermittent - continuous flow through some seasons of the year but little or no flow through other seasons.
Pr-Perennial - flows at all times except during extreme drought.

October 1975

TABLE 3 - STRUCTURE DATA - (CONT'D
(LATERAL IMPROVEMENTS)

Jordan Creek Watershed, Indiana

Reach	Open Drain Mi. 1/	Surface Drain Ft. 2/	Grass Waterway Ft. 3/	Tile Ft. 4/
A				
LD (LD-3A-8A) 5/		17,100	2,300	6,500
LD-1 (LD-1A)	.2	12,000	1,200	
LD-2 (LD-2A)	.5	3,800		2,400
LD-3	.2			
B				
JC (JC-13A-20A)		24,400	3,700	8,900
JC-3 (JC-3A-3C)	2.2	17,900		4,300
JC-4 (JC-4A-4E)	2.1	27,300		6,800
JC-5 (JC-5A)	.8	5,800		
C				
JC (JC-10-12A)		8,700		1,000
JC-2 (JC-2A-2C)	2.3	7,300	2,700	3,600
D				
LC (LC-4A-14A)		59,000	300	38,600
LC-1 (LC-1A-1C)	1.2	7,200		1,600
LC-2 (LC-2A-2E)	2.8	20,200		4,500
E				
JC (JC-6A-9A)	0.3	20,200	9,900	16,800
JC-1 (JC-1A-1C)	1.0	13,300	6,700	9,400
J				
MF-1	1.1	2,300		

1/ Open drains with minimum specifications of B. W. - 4', Depth-5' and S.S. - 3:1

2/ The term "surface drain" is an accepted local term which includes drainage mains or laterals and open channels.

3/ Grass Waterways: Same specifications as 2/

4/ Tile mains to be installed in conjunction with surface drains and grass waterways.

5/ Location designation (See Project Map)

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TABLE 3A - INVENTORY OF CHANNEL WORK

Jordan Creek Watershed, Indiana

Reach	Main Miles	Type of Work	Type of Channel	Flow Condition Before Project
A - Leak Ditch	2.1	II	M (1890)	I
Lat. Improvements	.4	II	M (1890)	E
	.5	I	0	E
B - Main	2.5	II	M (1890)	I
Lat. Improvements	4.8	II	M (1905)	E
	.3	I	0	E
C - Main	1.9	II	M (1905)	Pr
Lat. Improvements	1.1	II	M (1905)	E
	1.2	I	0	E
D - Little Creek	5.7	II	M (1915)	I
Lat. Improvements	2.6	II	M (1920)	E
	1.4	I	0	E
E - Main	1.5	III	M (1905)	Pr
Lat. Improvements	1.0	II	M (1950)	E
	0.3	I	0	E
J - Lat. Improvements	.2	II	M (1920)	E
	.9	I	0	E
Total Miles in Each Code Classification	28.4	I - 4.6 II -22.3 III - 1.5	M - 23.8 0 - 4.6	Pr - 3.4 I -10.3 E -14.7

Legend:

I - establishment of new channel including necessary stabilization measures.
II - enlargement of existing channel or stream.
III- debris removal.
M()- man-made ditch or previously modified channel.
0 - none or practically no defined channel.
Pr - perennial--flows at all times except during extreme drought.
I - intermittent--continuous flow through some seasons of the year but little or no flow through other seasons.
E - ephemeral--flows only during periods of surface runoff.

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TABLE 4 - ANNUAL COST

Jordan Creek Watershed, Indiana
(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost 2/	Operation and Maintenance Cost	Total
Reaches A-E	86,740	15,670	102,410
Reach J	2,470	180	2,650
Project Administration	15,360	XXXXXXXX XXXXXXXX	15,360
GRAND TOTAL	104,570	15,850	120,420

1/ Price Base: 1974

2/ 100 years @ 5 7/8 percent interest.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Jordan Creek Watershed, Indiana

(Dollars) 1/

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project	With Project	
Floodwater			
Crop and Pasture	18,960	8,330	10,630
Road and Bridges	4,780	4,100	680
Subtotal	23,740	12,430	11,310
Indirect	950	420	530
TOTAL	24,690	12,850	11,840

1/ Price Base: Agriculture prices current normalized (WRC-Feb. 1974). Other items current 1974.

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TABLE 6--COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Jordan Creek Watershed, Indiana

(Dollars)

Evaluation Unit	Average Annual Benefits 1/				Total	2/ Average Annual Cost	Benefit Cost Ratio
	Damage Reduction	More Intensive Land Use	Drainage	Secondary			
Reaches A-E	11,840	134,250	134,250	201,000	481,340	102,410	4.7:1.0
Reach J	--	4,250	4,250	6,220	14,720	2,650	5.6:1.0
Project Administration	XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX					15,360	XXXXXXX
GRAND TOTAL	11,840	138,500	138,500	207,220	496,060	120,420	4.1:1.0

1/ Price Base: Agriculture prices current normalized (WRC-Feb. 1974). Other items current 1974.

2/ From Table 4.

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INVESTIGATIONS AND ANALYSES

This section describes the type and intensity of the investigations and analyses which were made in formulating and evaluating the project. It describes the scope and intensity of surveys and investigations and the methods used in analyzing and interpreting the basic watershed data in order to determine the physical and economic feasibility of the project. The material is presented under the following appropriate headings.

LAND USE AND TREATMENT

The basic data for watershed land use and treatment was prepared by the sponsors with assistance from the local Soil Conservation Service and the Indiana Department of Natural Resources personnel. Information was obtained from the Conservation Needs Inventory, conservation plans, soil surveys, and local leaders familiar with the watershed.

Procedure used in developing the data began with a listing of predominant watershed soils by capability class, subclass, and treatment unit. Soils having similar use capabilities, treatment needs, and hydrologic characteristics were combined into soil groups. Present and anticipated future use and treatment of soils within each grouping was then determined.

Once finalized, the land treatment data provided the basis for estimations of "with" and "without" project rainfall runoff in the watershed. In so doing, an analytical framework was established within which watershed problems and effects of treatment could be studied.

FISH AND WILDLIFE

Some biology field studies have been made in or near this watershed. The rural letter carrier game surveys, spring growing counts, and sportsman questionnaires have been utilized in this study. The game census and fishery survey information has been supplied by the IDNR Division of Fish and Wildlife.

On-site observations by field biologists* indicated the proposed structural measures will be compatible with existing fish and wildlife resources within the watershed area providing current criteria are used. These criteria include, but are not limited to, such things as sediment traps, vegetative filter strips, one-side construction, replanting of woody cover, life of project easements with permanent markers and/or fence as needed, and other coordinated efforts in planting, design, construction, operation, and maintenance.

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*Official views of the Fish and Wildlife Service on the proposed project are only provided by the Regional Director or his representative.

Several multi-agency biology field reviews have been conducted. Early reviews were concentrated on those areas identified in the original work plan. A field review was conducted on the current planned project in November 1974, by representatives of the IDNR, Division of Fish and Wildlife, the U.S. Fish and Wildlife Service, Extension Service, and the Soil Conservation Service.

HYDRAULICS AND HYDROLOGY

The watershed was analyzed using procedures outlined in the National Engineers Handbook, Section 4, HYDROLOGY. This analysis was used to help design the structural works of improvement and for the economic evaluation.

Resource material

Basic data used for these studies were engineering field surveys, USGS topographic maps and water supply papers, aerial photographs and other available material.

Field surveys were completed on 21 valley sections, 35 channel sections and 27 bridges in Illinois, and 9 valley sections, 35 channel sections and 28 bridges in Indiana. Low area evaluations were obtained at additional locations. These surveys were used for the draft work plan of 1972. Additional surveys were completed in the spring of 1974 consisting of 13 valley sections, 12 channel sections, 2 bridges and 7 road profiles. These surveys were all in Indiana beginning at the state line and proceeding upstream to Tab, Indiana, on Jordan Creek and up Little Jordan Creek to the bridge east of Stewart.

Land use and treatment considerations

The runoff curve numbers were provided by the land treatment specialist with assistance from the district conservationist of the Warren County Soil and Water Conservation District. The runoff curve number for the without-project conditions is 79, for the land treatment only project the runoff curve number provided is 77, and for land treatment plus the works of improvement including the water management practices the runoff curve number provided is 75.

These runoff curve numbers were considered as antecedent moisture condition II and on the all-year basis.

Time of concentration

The hydrologic factor, Tc, was calculated by the velocity-travel-length method. The without-project Tc's were updated from the draft

Time of concentration - cont'd

work plan of 1972 because of the additional surveys and new data. The with-project Tc's were recalculated taking into consideration the water management practices.

Frequency analysis

Weather Bureau Technical Paper No. 40 rainfall depths by frequency for the 24-hour, all-year, partial duration storms, were plotted on semi-log paper.

Jordan Creek Watershed has no rain or stream gages located within its boundary. Therefore, studies were made of Weather Bureau rain gages and USGS stream gages in the vicinity of Jordan Creek. The hourly rain gages were located at Fowler, Collegeville, Chalmers, and Attica, Indiana, and at Hoopeston and Danville, Illinois. The daily rain gages used were located in Indiana at the following towns: Covington, Crawfordsville, Frankfort, and Lafayette. These gages were used to develop the composite mass rainfall curves. The stream gages studied were located on Carpenter Creek, Big Sugar Creek, Big Pine Creek located in Indiana, and the Vermilion River which serves as an outlet for Jordan Creek at Danville, Illinois. These stream gages were chosen for studies because their respective watersheds have predominantly the same topography, soils, and cropping systems as does Jordan Creek Watershed.

The storms that produced the peak annual series floods within the partial duration flood flows at the Vermilion River stream gage occurred at different seasons over the years, and the soils at one time or another were in all the antecedent moisture conditions I through III. The duration of these storms that produced the floods were from 1 day through 7 days with rainfalls from 0.9 of an inch to over 7 inches, which in turn produced runoffs of 0.4 of an inch to over 4 inches. These runoffs, when arrayed and plotted on semi-log paper and compared to TP40's 24-hour storm duration by frequency, calculated out to be RCN79.

Hydraulic studies

Twelve water surface profiles were run at Indiana University facilities for the without-project condition and the with-project condition using the Water Surface Profile Program Number 2. Full utilization of this program was made for the development of the channel design for this plan.

Flood routing

The flood routings were made using TR-20 procedures with the standard dimensionless hydrograph (K-484), using the facilities at Indiana University

Flood routing - cont'd

for the without-project condition, and the trial flood routings for project development. A complete array of storms were routed and they are as follows:

Frequency Percent Chance	(24-hour) Rainfall (in.)	Runoff (in.) Without Project RCN 79	Runoff (in.) With Project RCN 75
1	6.0	3.67	3.28
2	5.5	3.23	2.86
4	4.9	2.71	2.37
10	4.3	2.21	1.89
20	3.8	1.80	1.52
50	2.95	1.15	.93
100	2.6	.90	.71
200	2.0	.52	.38

Hydrologic effects

The flood routed peak discharges, q, were plotted versus volume of runoff in inches, Q. Likewise, water surface elevations were plotted versus volume of runoff in inches. These graphs were made for each evaluation section within the project area. Using the runoff depth by percent chance data developed in the frequency analysis, it was possible to read peak-frequency and elevation-frequency information from these charts. These data were also placed on spread sheets for each evaluation reach. Area flooded curves were developed and provided to the economist using the valley sections located in each evaluation reach. Discharge curves by frequency in cubic feet per second versus drainage area were developed and furnished to the engineer for channel design purposes.

ENGINEERING

Design of structural measures

The basic data used for channel designs and cost estimates were field surveys, USGS topographic maps, aerial photographs, geological investigations and field observations. Profiles were prepared from numerous cross sections, valley sections, and bridge surveys. They were used to determine bank full elevations, grades, and hydraulic gradients of the channels. Capacities used were based on discharges provided by the planning hydrologist.

Engineering studies leading to final structural formulation involved consideration of four alternate designs of channel improvements. No feasible flood detention structure sites were found for consideration. The first three alternate designs were for progressively decreasing capacity in main stream channels. The capacities approximated the discharges required by the B and C drainage curves of SCS National Engineering Handbook, Section 16. Results of flood routing the watershed with these designs were analyzed so that the design necessary to provide the required 1-year cropping season protection could be defined.

Construction of the channel will be done from one side only using a 3:1 side slope. The side will be chosen during the final design phase. Factors to be used in making this decision will be bank stability, quality of wildlife habitat, thermal pollution, and maintenance access. Bridge approaches will be constructed from both sides. Clearing will be minimized and will include only the area within the channel banks and area necessary for construction and spoil disposal.

An "aged" and "as Built" analysis of the channel design was made in accordance with current Service criteria. The allowable velocity and tractive force methods were used to analyze the soils encountered. Some minor deviation in the "as built" criteria was accepted recognizing a degree of risk is involved in establishing the initial stability. Additional work may be necessary during the establishment period to achieve the desired stability of the channels. This should be accomplished at a cost not exceeding 10 percent of the construction cost. The only major stability problem was in the upper portion of Reach A. Minor problems exist in Reach B. Protection was accomplished by using armor plating on the channel bottom and sides where needed. Approximately 3,170 cu. yds. of material was used for protection. The associated costs are incorporated in the project cost.

The debris removal in Reach E consists of the removal of a small log jam near station 595+00 and very minor debris removal (logs) throughout the remainder of the reach. Total estimated cost - $2,000. The scope of the work is such that the stability will not be affected.

Land rights for structural measures

Area needs and costs for permanent land rights for open channels were based on that area within the ditch banks, plus overbank lands out 15 feet on the unconstructed side, plus a 12-foot berm and the spoil bank to the crest on the constructed side. Permanent land rights boundaries are to be marked in the field, or fenced where adjacent lands are pastured, to protect the channel and mitigation areas.

The area to be placed in grassed waterways required permanent land rights and was figured to cost the value of the land. Access right-of-way to assure perpetual entry for maintenance is a part of the land rights costs for all structural measures.

Temporary land rights costs were figured to include the area outside permanent easements needed during construction, on which to maneuver equipment and spoil excavated material, when necessary. These will include open channels, surface drains, and grassed waterways.

No land rights costs were considered necessary for subsurface drains installed as a structural measure. This attitude was taken in view that no additional lands were involved beyond those for which land rights would be obtained for either surface drains or grassed waterways.

Cost estimates for structural measures

Yardage estimates were made by the average end area method. The channel construction and mitigation cost estimates were based upon unit prices determined from abstracts of bids on the most recent PL-566 contracts in Indiana. Values for land rights were estimated by the local sponsors.

The annual operation and maintenance costs were figured using record data on completed practices and anticipated costs for each type of improvement.

Supporting data available to design and construction engineers and regulatory agencies show detailed cost analyses.

GEOLOGY

The geologic investigation included a review of published surficial and bedrock geologic maps, soil survey reports, aerial photos, and geologic literature, as well as field investigations.

Erosion and sedimentation

Gross sheet erosion rates were calculated using the Universal Soil Loss Equation. Stream, gully, and other erosion rates were calculated as a percentage of the sheet erosion figures. Delivery ratios were modified using available SCS publications. Soils, land use, and land treatment data were supplied by the district and the area conservationists of the SCS.

Field investigations indicated that sediment and erosion damages were not severe enough to warrant a detailed economic and physical evaluation.

Channels

Preliminary channel investigations consisted of selected earth borings utilizing a hand-auger and hydraulic soil probe. Selected samples were submitted to the Soil Conservation Service Soil Mechanics Laboratory for classification and routine index tests. Based upon the results of this preliminary study, additional earth borings were made using both a hand-auger and power-assisted rotary drill rig. Additional soil samples were collected and analyzed. The results of the investigation and sample analyses were submitted to and discussed with the planning engineer as considerations for channel design.

The black surface soils in the upstream reaches are underlain by glacial till composed of silty and sandy clays with low to moderate plasticity. Most of the upstream channels have been reconstructed in the past with about 1.5 to 1.0 side slopes. The vegetated banks are stable.

The middle to lower main channel reaches contain materials similar to the upper reaches, but also have discontinuous sand and gravel lenses. The lenses have no apparent pattern of occurrence and are not continuous along the channel. The glacial till in these reaches is moderately plastic with some low plasticity material close to the surface. The channel banks are eroding on the outside of some stream meanders.

ECONOMICS

Identification of watershed problems and consideration of effects of proposed improvements provided the basis for evaluation of project benefits. Basic datum was obtained through interviews with watershed residents, Soil Conservation Service employees, and local watershed leaders. Field economic studies and information supplied by other watershed planning specialists supplemented basic interview data. Analysis of all project benefits was made through a comparison of future "with" and "without" project conditions. Information utilized and results obtained were reviewed for reasonableness and accuracy.

Floodwater damage

Floodwater damages were evaluated using the "frequency method" as described in Chapter 3 of the Economics Guide. Identification of the relationship between flood size and resulting flood damages provided the basis for damage determination under this method.

Crop and pasture

Evaluation of crop and pasture flood damages under the "frequency method" was achieved utilizing standardized crop depth-damage factors as a base. Factors used had been previously developed for evaluation of watershed projects throughout the northern portion of Indiana. Such factors relate flood depth and month of flood occurrence to expected crop losses expressed as a percentage of gross income. Sufficient interview information was obtained to support applicability of the factors for use in the watershed.

Composite acre, flood depth-damage factors were then developed. Incorporated into these factors were the above-mentioned crop damage factors plus data on future flood plain land use, projected crop yields and prices, and monthly cropping season probabilities of flood occurrence. Resultant composite acre values served as estimates of expected losses on a representative flood plain acre from various depths of flooding irrespective of the month of flood occurrence.

Application of the composite acre factors to acre-frequency information supplied by the planning hydrologist provided the means of determining damage-frequency relationships and subsequently average annual damages with and without-project. Such damages were adjusted to eliminate double counting arising through recurrent flooding in a given year. Basis for the adjustment was regression analysis of the ratio Y (average annual damages adjusted for recurrent flooding/unadjusted average annual damages) on the ratio R (average annual acres flooded/maximum flood plain acres).

Floodwater damages on a total of 1,390 flood plain acres were evaluated using this method.

Nonagricultural

Damage to nonagricultural property, although significant to the watershed as a whole, was not sufficiently concentrated in specific areas so as to be a major consideration in formulating structural measures for flood prevention. Damage evaluated was primarily to roads and bridges. Fragmented flood reports by watershed residents and county road officials were relied upon in estimated flood damages.

Specific attention was focused on gathering information on small floods of a size which could be expected to occur yearly as well as on a large flood of a size approximately a 10-year event. Available data were transferred to similar road and bridge damage points on which little or no historical information was available.

Evaluation was performed using the storm damage information obtained together with flood routings as a basis for constructing simple damage-frequency curves. Those damages appearing insignificant (less than $50 average annually) and those not appreciably affected by the project were screened from the evaluation process.

Indirect

Indirect damages were evaluated as a percentage of direct flood damages. Percentages utilized were 5 percent of crop and pasture damage and 20 percent of nonagricultural damage.

Joint flood prevention and drainage benefits

Flood prevention benefits of the more intensive use type were evaluated jointly with drainage benefits on the following acreages:

Reach A - 2,107 ac.	Reach D - 4,715 ac.
Reach B - 4,521 ac.	Reach E - 2,368 ac.
Reach C - 1,709 ac.	Reach J - 504 ac.
	TOTAL 15,924

Method of evaluation was the "net income" procedure as described in Chapter 3 of the Economics Guide. Benefits were determined on a composite acre basis for the typical water problem area as described under "Watershed Problems." Acres of benefit indicated above represent only 81 percent of the total problem area evaluated. This percentage compares to the combined precentages of water problem subareas 1, 2, and 3 discussed previously.

Extent of benefited area was determined by a sampling process. In total, 50 percent of the watershed area was sampled. Only those areas conforming to the typical water problem area were considered for benefit

Joint flood prevention and drainage benefits - cont'd

delineation of this type. Sample results indicated a spread in percentage of area benefited ranging from 42 to 58 percent. Average of all samples was 53 percent benefited area. Results from the sampling process were expanded to other watershed areas. A key to the overall evaluation was an assessment of expected crop yield increases which would result from the project under future conditions. Information supplied through farmer interviews, judgment of agronomic and soils specialists familiar with the area, and projected yield data developed by the Economic Research Service for the Ohio River Basin provided the basis for these determinations.

Land use projections were based largely on judgment. Local interviews set the framework for the projections. A summary of pertinent land use and yield data is shown below. Present condition information is recorded for general interest. It is significant to the evaluation only in reflecting the base point from which the projection of future condition land use and yields were made.

	Present Condition		Future Conditions					
			Without Project			With Project		
Crop	Yield	Land Use	Yield		Land Use	Yield		Land Use
		%			%			
Corn	120 bu.	33.7	150	bu.	52.5	176	bu.	52.5
Soybeans	37 bu.	16.3	51	bu	26.2	63	bu.	26.2
Wheat	42 bu.	5.5	59	bu.	4.3	68	bu.	4.3
Hay	3.5 t	21.8	4.5	t	4.3	5.2	t	4.3
Pasture	125 aud	4.4	75	aud	4.4	75	aud	4.4
Other	--	8.3	--		8.3	--		8.3
TOTAL		100.0			100.0			100.0

Gross income increase with project was then computed using current normalized prices. Deduction of increased cast production costs and associated costs for the installation of on-farm improvements supplied a measure of increased net income. This composite acre value is recorded below.

	(All Reaches)
Increased Gross Income	32.20
Increased Production Costs	1.35
Associated Costs	10.11
Increased Net Income	20.74

Figures presented above reflect full development values prior to the application of discounts for lag in accrual and lack of participation.

Joint flood prevention and drainage benefits - cont'd

A weighted average discount value of 0.813 was determined based on 50 percent of the area receiving full benefit from the onset of the project, another 40 percent requiring a gradual buildup to full benefit over a 10-year period, and the remaining 10 percent not participating.

Total primary benefits were determined by applying the composite acre net income increases to the benefited areas delineated by the sampling process, then discounting for lag in accrual. Results are shown:

	(Reaches A-E)	(Reach J)
Net Income	20.74	20.74
Benefited Area (acres)	15,420	504
Discount Factor	0.813	0.813
Subtotal	260,006	8,499

Benefits derived were assigned 50 percent to the flood prevention purpose and 50 percent to drainage.

Secondary benefits

Secondary benefits were evaluated based on benefit values and using the income multiplier.

Prices and interest rates

Current normalized prices as transmitted by the Water Resources Council in February 1974, served as the applicable price base for computation of project benefits and operation, maintenance, and replacement costs. Estimated construction costs for project installation were based on 1974 prices.

Annual equivalent of installation costs and project benefits were computed using a 5 7/8 percent interest rate. Private expenditures connected with the installation of on-farm improvements required for the realization of project benefits were converted to annual equivalents using an 8 percent interest rate.

Cost allocation

All structural improvements other than tile were considered multiple purpose drainage and flood prevention features. Tile was considered single purpose drainage installations. Joint costs on multiple purpose improvements were allocated under the first alternative as described in Chapter 3 in the Watershed Protection Handbook.

EXHIBITS

DEFINITION OF CONSERVATION PRACTICES AND LAND USE

CONSERVATION PRACTICES

CONSERVATION CROPPING SYSTEM

Growing crops in combination with needed cultural and management measures. Cropping systems include rotations that contain grasses and legumes as well as rotations in which the desired benefits are achieved without the use of such crops.

CONTOUR FARMING

Farming sloping cultivated land in such a way that plowing, preparing and planting, and cultivation are done on the contour. (This includes following established grades of terraces, diversions or controu strips.)

CROP RESIDUE USE

Using plant residues to protect cultivated fields during critical erosion periods.

CRITICAL AREA PLANTING

Stabilizing silt-producing and severely eroded areas by establishing vegetative cover. This includes woody plants, such as trees, shrubs or vines, and adapted grasses or legumes established by seeding or sodding to provide long-term ground cover. (Does not include Tree Planting mainly for the production of wood products.)

DIVERSION

A channel with a supporting ridge on the lower side constructed across the slope.

DRAINAGE FIELD DITCHES

A shallow graded ditch for collecting water within field, usually constructed with flat side slopes for ease of crossing. (This does not include drainage main or lateral, or grassed waterway or outlet.)

DRAINAGE MAIN OR LATERAL

An open drainage ditch constructed to a designed size and grade. Does not include drainage field ditch.

DEFINITION OF CONSERVATION PRACTICES AND LAND USE

CONSERVATION PRACTICES - CONT'D

GRADE STABILIZATION STRUCTURE

A structure to stabilize the grade or to control head cutting in natural or artificial channels. (Does not include structures used in drainage and irrigation systems primarily for water control.)

GRASSED WATERWAY OR OUTLET

A natural or constructed waterway or outlet shaped or graded and established in vegetation suitable to safely dispose run-off from a field, diversion, terrace, or other structure.

MINIMUM TILLAGE

Limiting the number of cultural operations to those that are properly timed and essential to produce a crop and prevent soil damage.

OPEN CHANNEL

Constructing or improving a channel, either natural or artificial, in which water flows with a free surface.

PASTURE AND HAYLAND MANAGEMENT

Proper treatment and use of pastureland or hayland.

PASTURE AND HAYLAND PLANTING

Establishing and re-establishing long-term stands of adapted species of perennial, biennial or reseeding forage plants. (Includes pasture and hayland renovation. Does not include grassed waterway or outlet on cropland.)

POND

A water impoundment made by constructing a dam or embankment, or by excavating a pit or "dugout".

SUBSURFACE DRAIN

A conduit, such as tile, pipe, or tubing, installed beneath the ground surface and which collects and/or conveys drainage water.

EXHIBIT 1

DEFINITION OF CONSERVATION PRACTICES AND LAND USE

CONSERVATION PRACTICES - CONT'D

TERRACE

An earth embankment or a ridge and channel constructed across the slope at a suitable spacing and with an acceptable grade.

TREE PLANTING

Planting tree seedlings or cuttings.

WILDLIFE UPLAND HABITAT MANAGEMENT

Retaining, creating or managing wildlife habitat other than wetland.

LAND USE

CROPLAND

Cropland includes all cultivated land used for field crops or hay in pasture or rotation; cropland temporarily idle or diverted from production under government programs; permanent hayland, orchards, vineyards and bush fruits; and open land from cropped and not converted to another use.

FOREST OR WOODLAND

Forest or woodland includes land that is at least 10% stocked with forest trees and capable of producing forest products or influencing a water regime, land that formerly grew trees and is not currently developed for non-forest use, and land that has been planted to trees.

OTHER LAND

Other land is non-federal rural land which is not classified as cropland, pasture or forest land. It includes strip mines, borrow and gravel pits, farmsteads, farm roads, ditches, rural non-farm residences, and idle, open rural non-farm land.

PASTURE

Pasture includes lands producing forage plants, principally introduced species, primarily for grazing and not included in cropland rotation; includes native pasture and may contain shade or timber trees if canopy is less than 10%.

(Reproduced from SCS Technical Guide Section IV and Indiana Soil and Water Conservation Inventory 1968)

EXHIBIT 2

SOIL LOSS CAN BE CONTROLLED...

WITH

MINIMUM TILLAGE...

AND/OR

CONTOUR FARMING.

POOR DRAINAGE CAN BE CORRECTED...

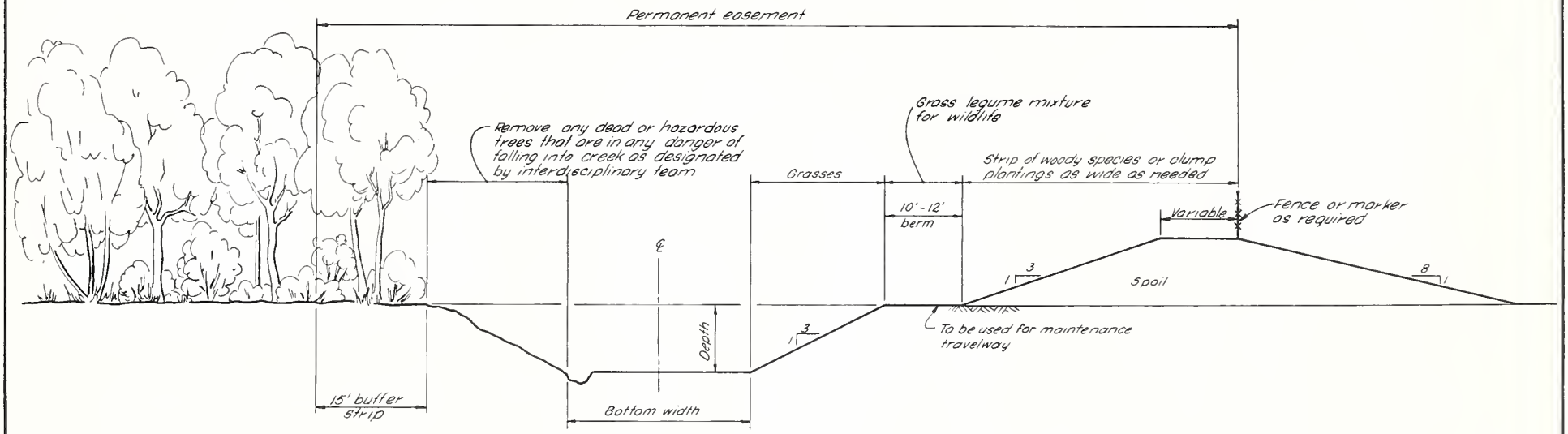
BY

INSTALLING A TILE SYSTEM...

AND/OR

SURFACE DRAINAGE.

Channel work from one side only preserves valuable wildlife habitat.



TYPICAL CHANNEL CROSS SECTION
(with berm)

Exhibit 4

5,E-32,984.1

IN-EDU 7-71

USDA-SCS-LINCOLN, NEBR. 1974

EXHIBIT 5

GRASSED WATERWAYS PROVIDE ADEQUATE PROTECTION FROM EROSION ON GENTLY SLOPING LAND ...

BUT

EROSION CONTROL STRUCTURES ARE NEEDED TO PROTECT THE SOIL FROM EROSIVE TURBULENCE OF WATER DROPPING FROM FIELD LEVEL INTO A ROAD CULVERT ...

OR

WATER DROPPING FROM FIELD LEVEL INTO AN OPEN OUTLET DITCH.

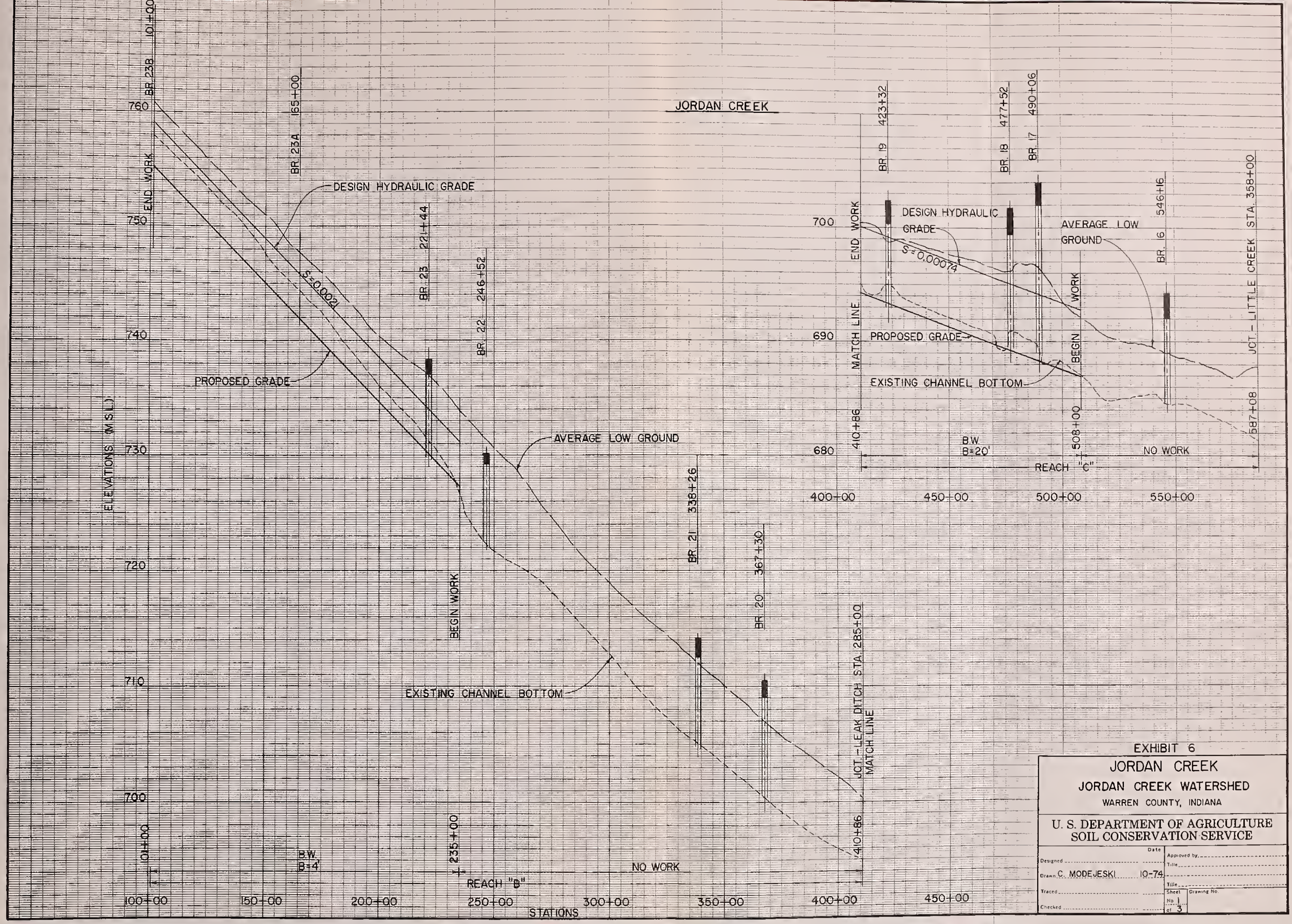


EXHIBIT 6

JORDAN CREEK

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed	Date	Approved by	
Drawn C. MODEJESKI	10-74	Title	
Traced		Title	
Checked		Sheet No. 1 of 3	Drawing No.

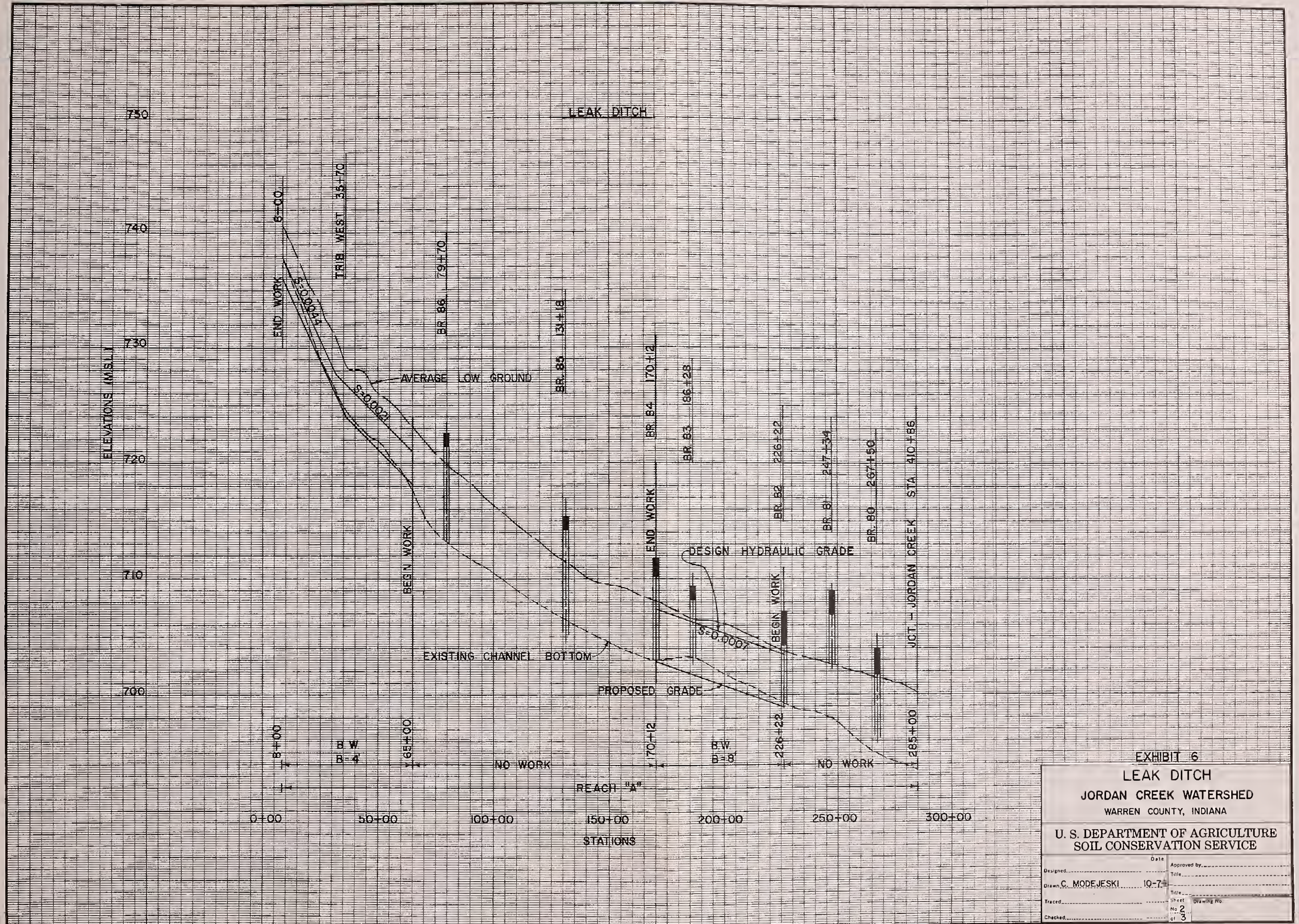


EXHIBIT 6

LEAK DITCH

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn C. MODEJESKI	10-7	Title	
Traced		Title	
Checked		Sheet No. 2 of 3	Drawing No.

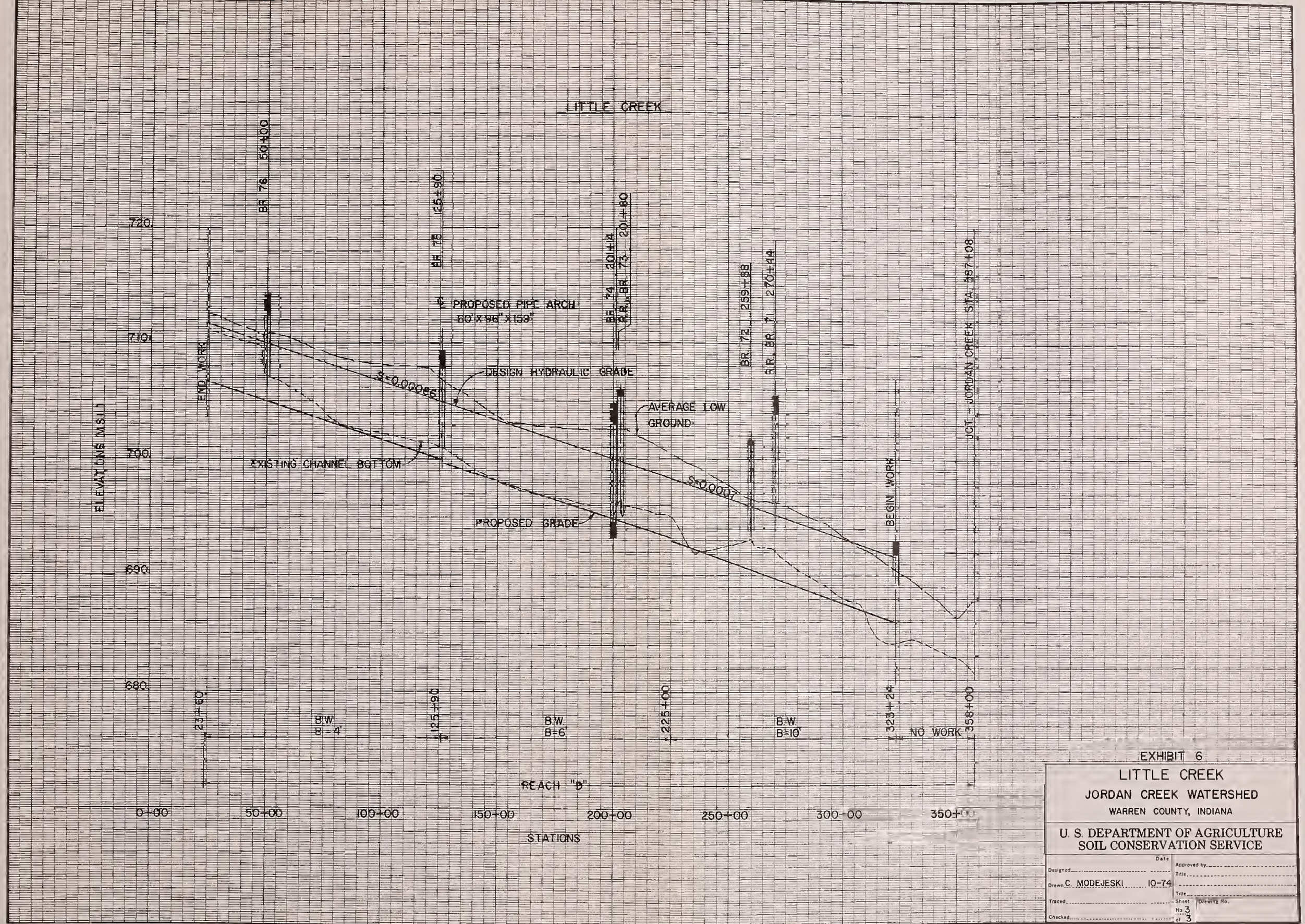


EXHIBIT 6

LITTLE CREEK

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date		
Designed		Approved by	
Drawn C. MODEJESKI	10-74	Title	
Traced		Title	
Checked		Sheet No. 3 of 3	Drawing No.

GENERAL SOIL INFORMATION

The General Soil Map (Exhibit 7C) of the Jordan Creek Watershed shows two main patterns of soils called soil associations. Each association contains a few major soils and several minor soils, and is named for the major soils. The soils in one association may be in another, but in a different pattern.

The General Soil Map is useful to people who want a general idea of the soils, who want to compare different parts of the watershed or who want to know the location of large tracts that are suitable for a certain kind of farm or non-farm land use. Such a map is not suitable for planning the management of a farm or field, or for selecting the exact location of a road, building or similar structure because the soils in any one association ordinarily differ in slope, depth, drainage, or other characteristics that affect management.

Detailed soil maps and information on soils and specific uses is available for much of the area encompassed by the watershed for this detailed information, please contact the field office of the Soil Conservation Service in Warren County.

SOIL INTERPRETATIONS

The interpretive table (Exhibit 7B) provides soil interpretations for 12 specific uses for each of the two soil associations shown on the General Soil Map of the Jordan Creek Watershed. The approximate percent of the association of each major soil and the total percent of all of the minor soils is given. Estimated limitations or suitability for each of the named soils for each of the 12 uses is given in terms of slight, moderate, or severe limitations or good, fair, poor or unsuited suitability. Beside each of the ratings the limiting soil properties or features are given by listing one or more numbers. These numbers correspond with those listed in the "Key to Principal Soil Limitations", at the bottom of the table. Soils rated as slight are estimated to have no principal soil limitations and are not referenced to the key.

SOIL LIMITATION CLASSES

Soils rated as "slight" have few or no limitations for the use. Soils rated as "moderate" have limitations which reduce to some degree their desirability when used for the purpose being considered. They require some corrective measures. Soils rated as "severe" have unfavorable soil characteristics that severely restrict their use and desirability for the purpose. A severe rating does not mean the soil cannot be used for a specific use. It does indicate problems during or after application of the use, unless special design, engineering or other corrective measures are used to overcome the limitations. Costs are usually greater than on soils rated slight or moderate, and many times costs are prohibitive.

SOIL SUITABILITY RATING

"Good", "fair", "poor" and "unsuited" are terms used to rate soils as a source of sand, gravel and roadfill. Soils rated as "good" have qualities such that they can be considered as a suitable resource material. Soils rated "fair" have some problems in the material that make them less desirable. Soils rated as "poor" have problems that greatly limit their suitability as a source. Soils rated as "unsuited" are physically unfit, or it is not practical to process the material.

Where used for "intensive cropping", "good" indicates soils are capable of producing sustained corn yields of 110 to 155 bushels or corn per acre under high levels of management. "Fair" indicates soils that will produce 70 to 110 bushels of corn and "poor" indicates those soils that will produce less than 70 bushels of corn per acre.

Where used for "woodland productivity", "good" indicates soils are capable of producing greater than 335 board feet per acre per year for adapted tree species. "Fair" indicates soils that will produce 260 to 335 feet and "poor" indicates those soils that will produce less than 260 board feet per acre per year.

USDA SOIL CONSERVATION SERVICE

IN COOPERATION WITH

PURDUE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

JORDAN CREEK WATERSHED

ESTIMATED SOIL LIMITATIONS OR SUITABILITIES FOR SELECTED USES

SOIL ASSN 1/ & % OF WATERSHED	SOIL SERIES 2/	DWELLINGS 3/		WASTE DISPOSAL 4/		LOCAL ROADS 5/	SUITABILITY AS SOURCE OF 6/			RECREATION 7/		8/	9/
		WITH BASEMENTS	WITHOUT BASEMENTS	SEPTIC TANK ABSORPTION FIELDS	SEWAGE LAGOONS	STREETS & PARKING AREAS	SAND	GRAVEL	ROADFILL	CAMPING AND PICNIC AREAS	PLAYGROUNDS & ATHLETIC FIELDS	INTN. CROPPING	WOODLAND PRODUCTIVITY
1 70%	Raub Chalmers Darroch	Severe: 3 Severe: 3 Severe: 3	Moderate: 3 Severe: 3 Moderate: 3,5	Severe: 2,3 Severe: 3 Severe: 2,3	Moderate: 3 Severe: 3 Moderate: 3	Severe: 5 Severe: 3,5 Severe: 5	Unsuited Unsuited Unsuited	Unsuited Unsuited Unsuited	Poor Poor Poor	Moderate: 3 Severe: 3 Moderate: 3	Moderate: 3 Severe: 3 Moderate: 3	Good Good Good	No Data No Data No Data
2 30%	Sidell Dana Darroch	Slight Moderate: 3 Severe: 3 Severe: 3	Slight Slight Moderate: 3,5 Moderate: 3,5	Moderate: 1,2 Moderate: 2 Severe: 2,3 Severe: 2,3	Moderate: 1,7 Moderate: 7 Moderate: 3 Slight	Severe: 5 Severe: 5 Severe: 5 Severe: 5	Unsuited Unsuited Unsuited Unsuited	Unsuited Unsuited Unsuited Unsuited	Poor Poor Poor Poor	Slight Slight Moderate: 3 Moderate: 2,3	Moderate: 1 Moderate: 1 Moderate: 3 Moderate: 2,3	Good Good Good Good	No Data No Data No Data No Data

KEY TO POSSIBLE SOIL LIMITATIONS: 1. Slope 2. Slow permeability 3. Seasonal high water table 4. Flood hazard 5. Poor stability 6. Adverse soil texture 7. Excessive permeability

1/ Soil Association: The numbers in this column correspond with the numbered soil associations on the General Soil Map of the watershed. Each soil association is named for the major soils. The percent of each soil association in the watershed is shown.

2/ Soil Series: This column shows the name of each major soil in each association.

3/ Dwellings

With Basements: Ratings are for undisturbed soils that are evaluated for single family dwellings and other structures with similar foundation requirements. Excluded are buildings of more than three stories and other buildings with foundation loads in excess of those equal to three story dwellings. No specific bearing strength is estimated or implied.

Without Basements: The same qualifications as given above for dwellings--with basements apply here except that seasonal high water tables are not as restrictive.

4/ Waste Disposal

Septic Tank Absorption Fields: Ratings are for shallow, subsurface tile absorption fields and do not include alternative systems.

5/ Local Roads, Streets, & Parking Areas: Ratings are for improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year.

6/ Suitability As A Source Of

Sand: This column provides guidance about where to look for sand. Soil rated "good" contains a source of clean sand. "Fair" indicates sand with some fine material. "Poor" indicates fine material costly to remove. "Unsuited" indicates sand is not available.

Gravel: The purpose of this column is to provide guidance about where to look for gravel. The explanation of the ratings for "sand" (above) apply also to "gravel"

Roadfill: Refers to soil material moved from its original location and used in road construction. Generally it serves as the subgrade or foundation for the road. The whole soil, to a depth of six feet, is given one rating, assuming it will be mixed in handling.

7/ Recreation

Camp and Picnic Areas: Ratings apply to soils to be used intensively for tents and small camp trailers and the accompanying activities of outdoor living and for park-type picnic areas.

Playgrounds and Athletic Fields: Ratings apply to soils to be used intensively for playgrounds for baseball, football, volleyball and other similar organized games. These areas are subject to intensive foot traffic.

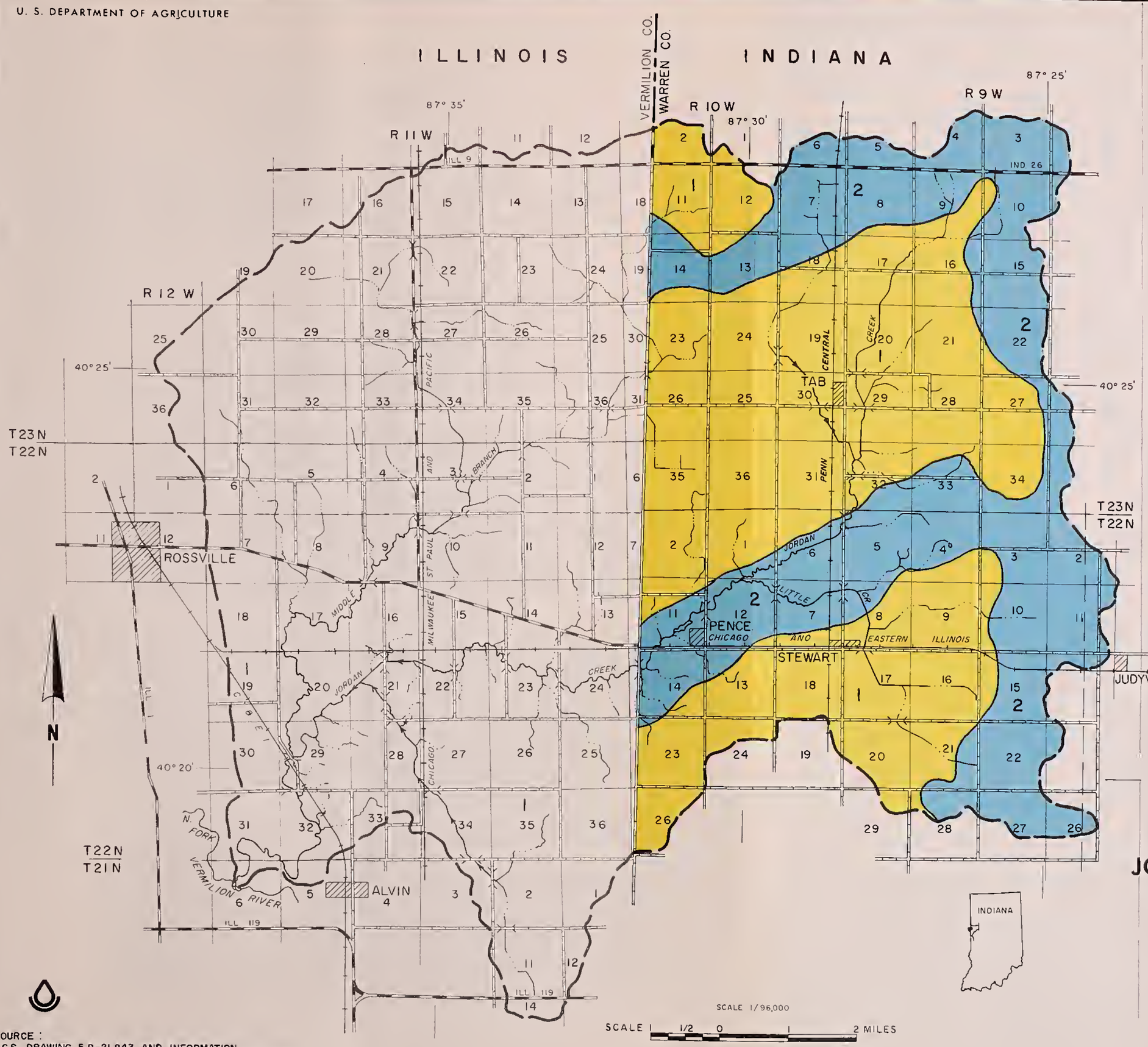
8/ Intensive Cropping: The ratings are based on the potential productivity of soils to produce sustained corn yields under high levels of management.

9/ Woodland Productivity: The ratings are based on the potential productivity of soils for their primary adapted species.

Exhibit 7B

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

- STATE LINE
- CIVIL TOWNSHIP LINE
- US TOWNSHIP LINE
- SECTION LINE
- PAVED ROAD
- GRAVEL ROAD
- DIRT ROAD
- RAILROAD
- CROSSING -GRADE
- CROSSING - ROAD UNDER
- BRIDGE
- PERENNIAL STREAM
- INTERMITTENT STREAM
- WATERSHED BOUNDARY

SOIL ASSOCIATIONS

1 RAUB, CHALMERS, DARROCH

2 SIDELL, DANA, DARROCH

GENERAL SOILS MAP

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

EXHIBIT 7c

SOURCE :
SCS DRAWING 5,P-21,843 AND INFORMATION
FROM FIELD TECHNICIANS. POLYCONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1975

REV. 2-75
5,N-28,609

Exhibit 7D

DESCRIPTIONS OF SOIL ASSOCIATIONS ON THE GENERAL SOIL MAP

The general soil map shows two soil associations in the watershed. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A description of each soil association on the general soil map follows:

1. Raub-Chalmers-Darroch association: Deep, nearly level and gently sloping, somewhat poorly drained and poorly drained loamy soils formed in loess and the underlying glacial till and outwash and the underlying glacial till.

   Raub soils are gently sloping and somewhat poorly drained. They formed in loess and the underlying glacial till. Their surface layer typically is a very dark brown silt loam about 13 inches in thickness. The subsoil is about 30 inches in thickness. In sequence from the top, the upper part is dark grayish brown friable silty clay loam, 5 inches in thickness; the next 17 inches are yellowish brown firm silty clay loam; and the lower 8 inches are yellowish brown friable clay loam. The calcareous underlying material, to a depth of about 60 inches, is yellowish brown and gray loam.

   Chalmers soils are nearly level and poorly drained. They formed in loess and the underlying glacial till. Their surface layer typically is a black silty clay loam about 15 inches in thickness. The subsoil is about 33 inches in thickness. In sequence from the top, the upper part is grayish brown firm silt clay loam, 4 inches in thickness; the next 20 inches are olive gray firm silty clay loam; and the lower 9 inches are gray firm loam. The calcareous underlying material, to a depth of about 60 inches, is yellowish brown and dark gray loam.

   Darroch soils are nearly level to gently sloping and somewhat poorly drained. They formed in outwash. Their surface layer typically is black silt loam about 13 inches in thickness. The subsoil is about 24 inches in thickness. In sequence from the top, the upper part is very dark grayish brown firm silty clay loam about 5 inches in thickness; the next 11 inches are dark grayish brown firm clay loam; the lower 8 inches are a grayish brown friable loam. The calcareous underlying material, to a depth of about 60 inches, is gray and light olive brown stratified silt loam, loam, fine sand and very fine sand.

2. Sidell-Dana-Darroch association: Deep, nearly level to moderately sloping, somewhat poorly drained to well drained loamy soils formed in loess and the underlying glacial till, outwash and the underlying glacial till, and glacial till.

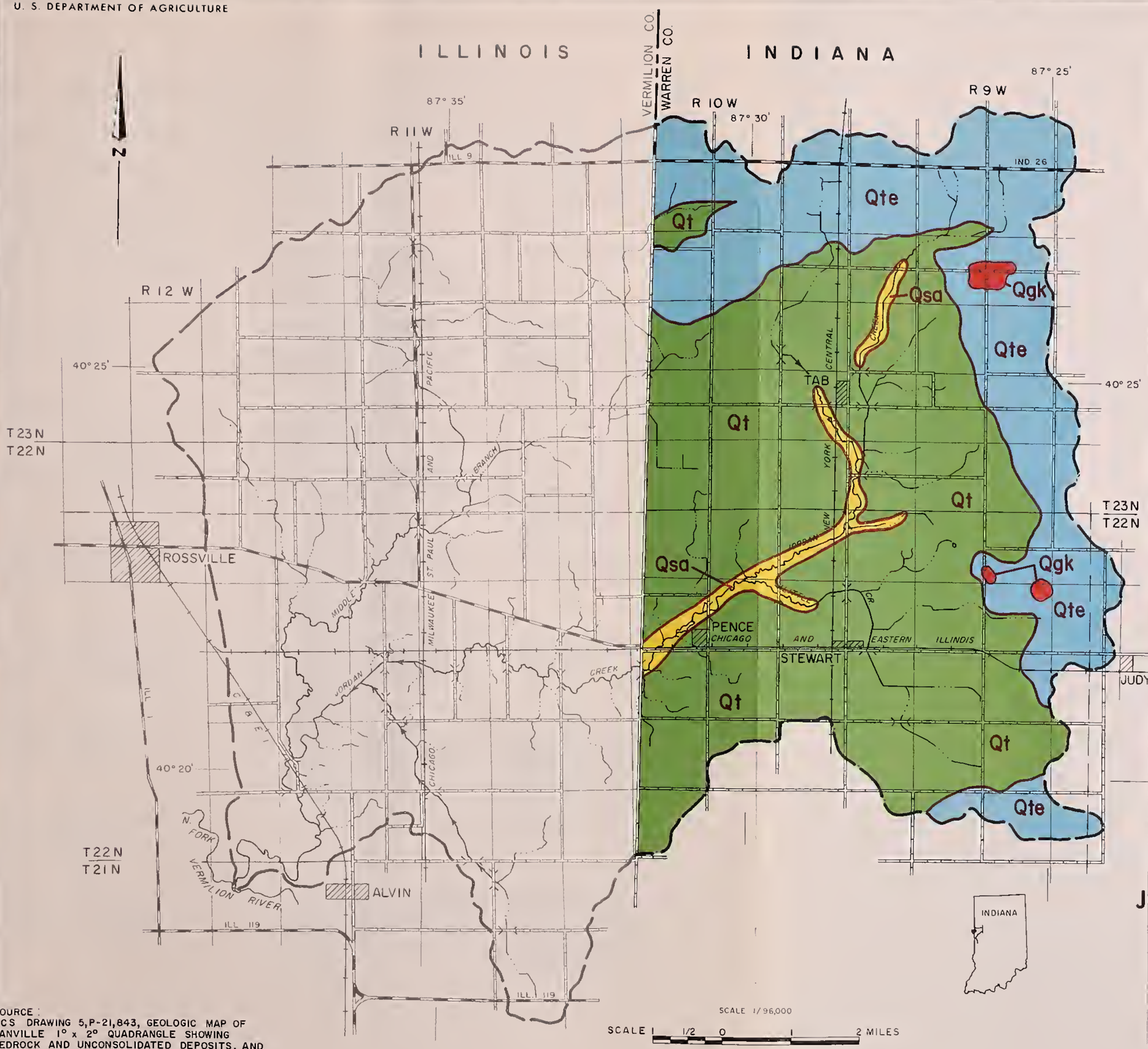
Sidell soils are gently sloping and moderately sloping and well drained. They formed in loess and the underlying glacial till. Their surface layer typically is very dark grayish brown silt loam about 14 inches in thickness. The subsoil is about 30 inches in thickness. In sequence from the top, the upper 14 inches are brown firm silty clay loam; the next 10 inches are brown firm clay loam; and the lower 6 inches are yellowish brown firm clay loam. The calcareous underlying material, to a depth of about 60 inches, is yellowish brown loam.

Dana soils are nearly level and gently sloping and moderately well drained. They formed in loess and the underlying till. Their surface layer typically is very dark grayish brown silt loam about 16 inches in thickness. The subsoil is 44 inches in thickness. In sequence from the top, the upper 16 inches are dark yellowish brown firm silty clay loam with mottles in the lower part; the next 17 inches are dark yellowish brown firm mottled clay loam; and the lower 11 inches are dark brown friable mottled loam. The calcareous underlying material, to a depth of about 66 inches, is a brown mottled loam.

Darroch soils are nearly level to gently sloping and somewhat poorly drained. They formed in outwash. Their surface layer typically is black silt loam about 13 inches thick. The subsoil is about 24 inches in thickness. In sequence from the top, the upper part is very dark grayish brown firm silty clay loam about 5 inches in thickness; the next 11 inches are dark grayish brown firm clay loam; the lower 8 inches are a grayish brown friable loam. The calcareous underlying, to a depth of about 60 inches, is gray and light olive brown stratified silt loam, loam, fine sand, and very fine sand.

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



LEGEND

- STATE LINE
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- CROSSING - ROAD UNDER
- BRIDGE
- PERENNIAL STREAM
- INTERMITTENT STREAM
- WATERSHED BOUNDARY

EXPLANATION

Qt / Qte — GLACIAL TILL. Qt, MAINLY GROUNO-MORAINE OEPOSITS WHICH ARE TOPOGRAPHICALLY LOWER THAN THE MORE HUMMOCKY OR RIOGELIKE ENO-MORAINE (Qte) OEPOSITS.

Qsa — MOSTLY ALLUVIUM WITH SOME VALLEY-TRAIN DEPOSITS (MOSTLY SAND, GRAVEL, ANO SILT).

ICE-CONTACT STRATIFIEO ORIFT (MOSTLY GRAVEL ANO SAND).

GENERALIZED SURFICIAL GEOLOGY MAP

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

EXHIBIT 8

SOURCE :
SCS DRAWING 5,P-21,843, GEOLOGIC MAP OF DANVILLE 1° x 2° QUADRANGLE SHOWING BEDROCK AND UNCONSOLIDATED DEPOSITS, AND THE INDIANA GEOLOGICAL SURVEY REGIONAL GEOLOGIC MAP NO. 2, 1966. POLYCONIC PROJECTION

USDA-SCS-LINCOLN, NEBR. 1975

2-13-75
5,0-34,999

MAMMALS OCCURRING IN THE VICINITY OF JORDAN CREEK WATERSHED

Name	Habitat	Notes on Local Populations
Opossum Didelphis marsupialis	farming areas and woodlands	common definitely present
Eastern mole Scalopus aquaticus	gardens, fields lawns and meadows avoids dry soils	probably present
Masked shrew Sorex cinerus	moist situations forests, open country, brushland	probably present (one of the commonest of the shrews)
Least shrew Cryptotis parva	inhabits open grassy areas and marshes	probably present
Shorttail shrew Blarina brevicauds	is found in nearly every land habitat available	present - one of the commonest mammals of eastern United States
Keen's myotis Myotis keenii	caves, mine tunnels hollow trees, buildings, storm sewers	probably present
Little brown myotis Myotis lucifugus	caves, mine tunnels hollow trees and buildings	probably present
Indiana myotis Myotis sodalis	caves in winter manmade structures and hollow trees in summer	may be present rare over most of its range-W/S on on edge of range
Silver-haired bat Lasionycteris noctivagans	wooded areas	probably present
Big brown bat Eptesicus fuscus	caves, mine tunnels rock crevices, near water, wooded areas, buildings	probably present one of the commonest and most widely distributed of our bats

Name	Habitat	Notes on Local Populations
Evening bat Nycticeius humeralis	hollow trees and buildings	probably present rare in the north
Red bat Lasiurus borealis	forested areas	probably present
Hoary bat Lasiurus cinerus	forested areas	probably present
Raccoon Procyn lotor	along streams and lake borders, near wooded areas or rock cliffs	common definitely present
Least weasel Mustela rixosa	not restricted	may be present rare over most of its range-W/S on edge of range
Longtail weasel Mustela frenata	not restricted near water	probably present most widely distributed and most common of the weasels
Mink Mustela vision	along streams and lakes	common present
Striped skunk Mephitis mephitis	found practically all land habitats	common definitely present
Red fox Vulpes fulva	mixture of forest and open country preferred	common present
Gray fox Urocyon cinereoargenteus	Chaparral, open forests and rimrock country	probably present
Coyote Canis latroms	prairies, open woodlands, brushy or boulder strewn areas	not common might be present
Woodchuck Mormota monax	open woods, brushy and rocky ravines	definitely present

Name	Habitat	Notes on Local Populations
Franklin ground squirrel Citellus franklini	prairie	may be present W/S extreme east edge of range
Thirteen-lined ground squirrel Citellus tridceemlineatus	grassy areas sometimes along roads	probably present
Eastern chipmunk Tamias striatus	deciduous forests, brushy areas	common definitely present
Eastern grey squirrel Soiurus carolinensis	hardwood forests with nut trees	probably present
Eastern fox squirrel Siurus niger	open hardwood lots in north, pine forests with clearings in south	common definitely present
Southern flying squirrel Glaucomys volans	woodlots and forests of deciduous or mixed deciduous and coniferous trees	probably present
Muskrat Ondatra aibethica	marshes, edges of ponds, lakes and streams, cattails, water lilies	common definitely present
Plains pocket gopher Geomys bursarius	deep soils in farming areas, alfalfa and other hay fields	may be present W/S on edge of range
White-footed mouse Peromuscus leucopus	woods or brushy areas preferred sometimes open areas	definitely present
Deer mouse Peromuscus maniculatus	open to brushy or wooded areas, dry land	definitely present
Southern bog lemming Synaptomus cooperi	low damp bogs and meadows with heavy growth of vegetation	probably present

Name	Habitat	Notes on Local Populations
Meadow vole Microtus pennsylvanious	low moist areas or high grass lands with rank growths of vegetation near streams, lakes and swamps	probably present
Prairie vole Microtus ochrogaster	open prairies, fence rows, r.r. rights-of-way and old cemeteries feeding, but appears in various land habitats not restricted	probably present
Pine vole Microtus pinetorum	usually a forest floor with a thich layer of duff, deciduuous forest in north, pine in south	probably present
Meadow jumping mouse Zapus hudsonius	damp meadow and forest areas	may be present
Eastern cottontail Sylvilagus floridanus	heavy brush, strips of forest with open areas nearby, edges of swamps, weed patches	definitely present
Whitetail deer Odocoileous virginionus	forest, swamp and open brushy areas woodlands in cropland areas	probably present

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Common Loon	M	Rare
Red-throated Loon	M	Rare
GREBES		
Horned	M	Rare
Pied Billed	R&M	Common
Double Breasted Cormorant	M	Very Rare
HERONS		
Great Blue	SR&M	Common
Egrets		
American	SR&M	Rare
Green	SR	Common
Black-crowned Night	M	Rare
BITTERNS		
American	M	Rare
Least	SR&M	Rare
GEESE		
Canada	M	Common
Snow	M	Uncommon
Blue	M	Uncommon
DUCKS		
Mallard	WR&M	Common
Black	WR&M	Common
Gadwall	M	Uncommon
Baldpate	M	Uncommon
Pintail	M	Uncommon
Green-winged Teal	M	Uncommon
Blue-winged Teal	M	Uncommon
Shoveller	M	Uncommon
Wood	SR&M	Common
Redhead	M	Rare
Ring-nicked	M	Common
Canvas-back	M	Rare
Lesser Scaup	M	Common
American Golden-eye	WR&M	Common
Buffle-head	M	Uncommon
Old-squaw	M	Accidental
White-winged Scoter	M	Accidental
Ruddy	M	Uncommon
Hooded Merganser	M	Uncommon
American Merganser	M	Uncommon
Red-breasted Merganser	M	Uncommon

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Turkey Vulture	R	Common
Black Vulture	SR	Uncommon
HAWKS		
Sharp-shinned	R	Uncommon
Cooper's	R	Uncommon
Red-tailed	R	Common
Red-shouldered	R	Common
Broad-winged	SR	Uncommon
Rough-legged	WR	Uncommon
Bald Eagle	Winter Visitor	Very Rare
Marsh	R&M	Uncommon
Osprey	M	Rare
Duck (endangered)	M	Accidental
Pigeon	M	Rare
Bob-white	R	Common
Ring-necked Pheasant	R	Uncommon
Sandhill Crane	M	Rare
RAILS		
King	SR	Rare
Virginia	SR	Rare
Sora	SR	Rare
Florida Gallinule	SR&M	Rare
Coot	M	Uncommon
PLOVERS		
Piping	M	Rare
Semipalmated	M	Rare
Killdeer	R	Common
Golden	M	Uncommon
Black-bellied	M	Uncommon
Ruddy Turnstone	M	Rare
Woodcock	SR	Common
Wilson's Snipe	M	Rare
Upland Plover	M	Rare
Spotted Sandpiper	SR	Common
Solitary Sandpiper	M	Uncommon
Greater Yellowlegs	M	Rare
Lesser Yellowlegs	M	Rare
Pectoral Sandpiper	M	Uncommon
Least Sandpiper	M	Uncommon
Dowitcher	M	Rare
Stilt Sandpiper	M	Very Rare
Sanderling	M	Very Rare

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Blue-gray Gnatcatcher	SR	Common
Golden-crowned Kinglet	M	Rare
Ruby-crowned Kinglet	WR	Uncommon
American Pipit	M	Uncommon
Cedar Waxwing	R	Common
Migrant Shrike	R	Uncommon
Starling	R	Common
VIREOS		
White-eyed	SR	Uncommon
Bell's	SR	Rare
Yellow-throated	SR	Uncommon
Red-eyed	SR	Common
Philadelphia	M	Uncommon
WARBLERS		
Black and White	SR	Common
Prothonotary	SR	Uncommon
Worm-eating	SR	Rare
Golden-winged	M	Rare
Blue-winged	M	Uncommon
Tennessee	M	Common
Orange-crowned	M	Rare
Nashville	M	Common
Parula	SR	Uncommon
Yellow	SR	Common
Magnolia	M	Common
Cape May	M	Rare
Black-throated Blue	M	Rare
Myrtle	M	Common
Black-throated Green	M	Common
Cerulean	SR	Common
Blackburnian	M	Common
Yellow-throated (Sycamore)	SR	Uncommon
Chestnut-sided	M	Common
Bay-breasted	M	Common
Black-poll	M	Uncommon
Pine	M	Rare
Prairie	SR	Rare
Palm	M	Common
Oven-bird	SR	Common
Northern Water Thrush	M	Rare
Louisiana Water Thrush	SR	Common

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Kentucky	SR	Common
Connecticut	M	Rare
Mourning	M	Rare
Yellow-throat	SR	Common
Yellow-breasted Chat	SR	Uncommon
Hooded	M	Rare
Wilson's	M	Rare
Canada	M	Uncommon
Redstart	M	Common
English Sparrow	R	Very Common
Bobolink	M	Uncommon
E. Meadowlark	R	Common
W. Meadowlark	R	Uncommon
Red-wing	R	Common
Orchard Oriole	SR	Uncommon
Baltimore Oriole	SR	Uncommon
Rusty Blackbird	M	Uncommon
Grackle	R	Common
Cowbird	SR	Common
Scarlet Tanager	SR	Uncommon
Summer Tanager	SR	Common
Cardinal	R	Common
Rose-breaster Grosbeak	M	Uncommon
Indigo Bunting	SR	Common
Dickcissel	SR	Uncommon
Purple Finch	WR	Uncommon
Goldfinch	R	Common
Towhee	R	Common
SPARROWS		
Savannah	M	Uncommon
Grasshopper	SR	Uncommon
Henslow's	SR	Uncommon
Vesper	WR	Uncommon
Lark	M	Rare
Bachman's	SR	Rare
Slat-colored Junco	WR	Common
Tree	WR	Common
Chipping	SR	Common

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Least	M	Common
Wood Pewee	SR	Common
Olive-sided	M	Rare
Horned Lark	R	Common
SWALLOWS		
Tree	M	Uncommon
Bank	SR	Uncommon
Rough-winged	SR	Uncommon
Barn	SR	Common
Cliff	M	Uncommon
Purple Martin	SR	Common
Blue Jay	R	Common
Crow	R	Common
Black-capped Chickadee	R&M	Common
Carolina Chickadee	R	Common
Tufted Titmouse	R	Common
White-breasted Nuthatch	SR	Uncommon
Red-breasted Nuthatch	WR	Rare
Brown Creeper	WR	Common
WRENS		
House	SR	Common
Winter	WR	Rare
Bewick's	Visitor	Rare
Carolina	R	Common
Long-billed Marsh	M	Rare
Short-b9lled Marsh	M	Rare
Mockingbird	R	Common
Catbird	SR	Common
Brown Thrasher	SR	Common
THRUSHES		
Robin	R	Common
Wood	SR	Common
Hermit	M	Common
Olive-backed	M	Uncommon
Gray checked	M	Rare
Veery	M	Uncommon
Bluebird	R	Uncommon

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
GULLS		
Herring	M	Uncommon
Ring-billed	M	Uncommon
Bonaparte's	M	Rare
TERNS		
Foster's	M	Very Rare
Common	M	Rare
Caspian	M	Very Rare
Black	M	Very Rare
Mourning Dove	R	Common
Yellow-billed Cuckoo	SR	Uncommon
Black-billed Cuckoo	SR	Uncommon
OWLS		
Barn	R	Uncommon
Screech	R	Uncommon
Great Horned	R	Common
Barred	R	Common
Long-eared	WR	Uncommon
Short-eared	WR	Uncommon
Whip-poor-will	SR	Uncommon
Nighthawk	SR&M	Common
Chimney Swift	SR	Common
Rubythroated Hummingbird	SR	Common
Belted Kingfisher	SR	Common
WOODPECKERS		
Flicker	R	Common
Pileated	R	Rare
Red-bellied	R	Uncommon
Red-headed	R	Common
Yellow-bellied Sapsucker	WR	Uncommon
Hairy	R	Uncommon
Downy	R	Common
FLYCATCHERS		
Kingbird	SR	Common
Crested	SR	Common
Phoebe	SR	Common
Arcadian	SR	Common
Alder	SR	Uncommon

JORDAN CREEK WATERSHED

Potential Birds in Watershed and Surrounding Area

Species	Migrant or Resident	Occurence in W/S
Field	R	Common
White-crowned	M	Common
White-throated	M	Common
Fox	WR&M	Uncommon
Lincoln's	M	Rare
Swamp	WR	Rare
Song	R	Common
Lapland Longspur	Winter Visitor	Uncommon
Snow Bunting	Winter Visitor	Uncommon

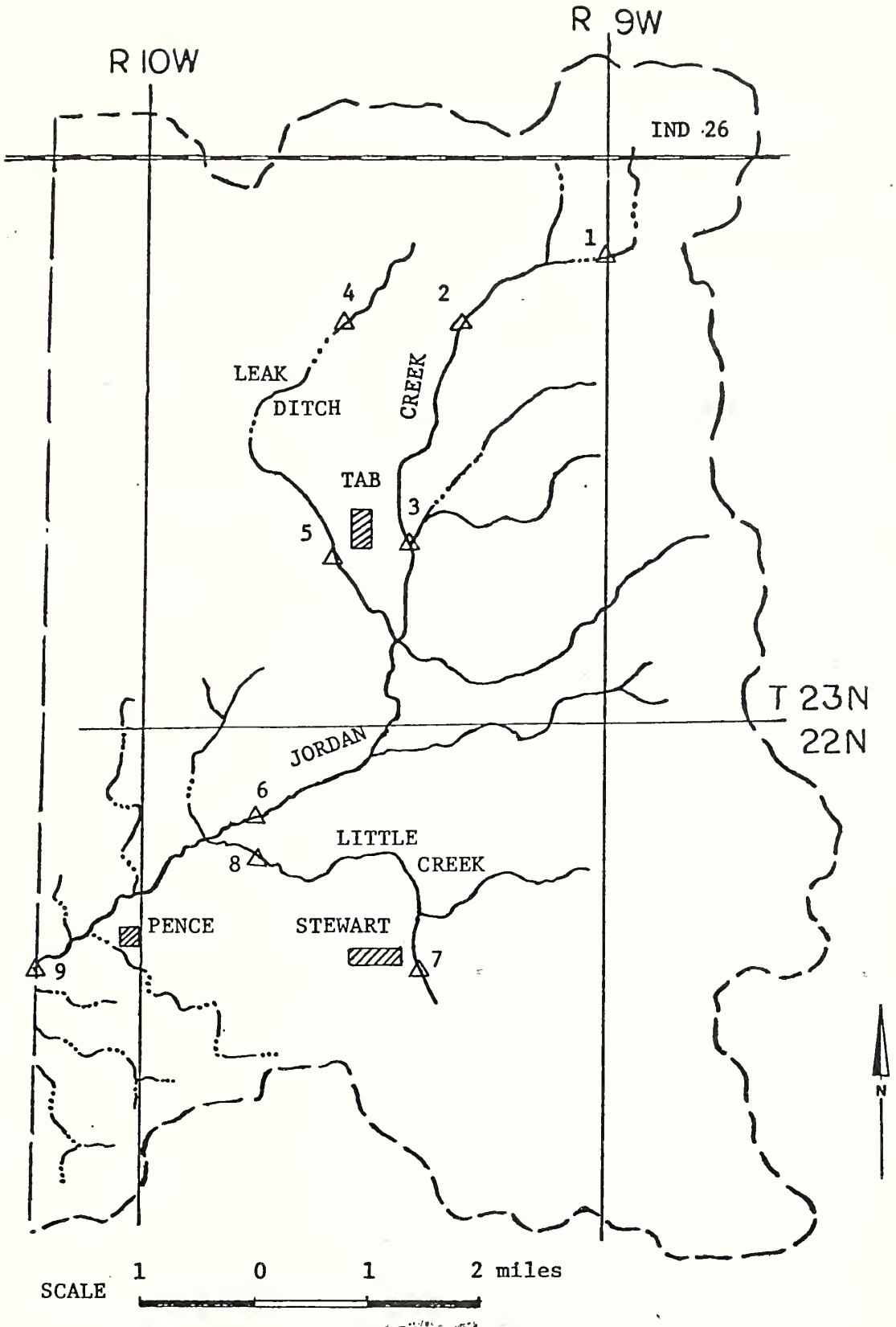

EXHIBIT 10

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

(EXHIBIT 11)

SUMMARY OF JORDAN CREEK WATER-QUALITY DATA COLLECTED
(September 24, 1974)

	Site Numbers				
	3	5	6	8	9
Drainage area (Square Miles)	11.7	5.2	26.6	15.6	51.2
Time	1420	1520	1700	1730	1810
Discharge (cfs)	.25	.09	.44	.13	.59
Water Temp. (^{o}C)	19.3	21.0	19.3	16.0	16.2
**pH, Field	8.2	7.2	8.6	8.3	8.5
Specific Conductance (umhos)	602	635	526	647	559
Dissolved oxygen (% Sat.)	97	92	126	92	97
Calcium	66	75	64	83	75
Magnesium	33	32	20	20	20
**Dissolved oxygen	8.9	8.3	11.6	9.1	9.6
Potassium	1.4	2.1	1.8	2.4	1.7
Sodium	5.3	8.7	7.0	6.8	6.7
Bicarbonate	260	332	227	286	246
Carbonate	0	0	0	0	0
Chloride	16	10	16	12	15
Fluoride	.3	.5	.3	.4	.3
Sulfate	63	36	57	67	59
Silica dioxide	4.1	11	3.9	5.6	4.9
Dissolved solids	318	341	283	339	305
Total Alkalinity (as CaCO)	213	272	186	235	202
Total hardness (as CaCO)	300	320	240	290	270
Noncarbonate hardness (as CaCO)	87	47	56	55	68

MILLIGRAMS PER LITRE

**Readings vary with biological activity

MILLIGRAMS PER LITRE

	Site Numbers				
	3	5	6	8	9
Ammonia, dissolved (as N)	.15	.23	.11	.18	.
Organic nitrogen dissolved (as N)	.19	.20	.33	1.1	.
Kjeldahl nitrogen dissolved (as N)	.34	.43	.44	1.3	.
Nitrite dissolved (as N)	0.00	0.00	0.00	0 0.00	0.
Nitrate dissolved (as N)	.19	.04	.08	.10	.
Orthophosphate dissolved (as P)	.01	.02	.01	.02	.
Phosphate dissolved (as P)	.01	.03	.01	.03	.
Organic carbon dissolved	4.8	5.3		5.9	5.
Aluminum total	.28	.75		.18	.
Iron total	.54	1.60		1.00	1.
Iron dissolved	.06	.08	.04	.08	.
Manganese total	.09	.50		.25	.
Manganese dissolved	.04		.05	.12	.
Fecal coliform*	220	240	1400	1200	770
Fecal streptococci*	330	210	85	130	140

SURFACE WATER QUALITY ANALYSES - SEPTEMBER 24, 1974

Site	Site Location	Discharge (cfs)	W. Temp. (°C)	SC (umhos)	DO (% Sat.
1	Jordan Creek	0.08	14.6	593	134
2	Jordan Creek	0.16	15.0	690	85
3	Jordan Creek	0.40	18.8	629	105
4	Leak Ditch	0.05	16.1	652	105
5	Leak Ditch	0.12	10.5	666	105
6	Jordan Creek	0.48	15.2	647	111
7	Little Creek	No Flow			
8	Little Creek	0.32	14.2	689	101
9	Jordan Creek	0.72	15.0	606	118

*Colonies per 100 millitres

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

PROJECT MAP

JORDAN CREEK WATERSHED

WARREN COUNTY, INDIANA

LEGEND

- STATE LINE
- CIVIL TOWNSHIP LINE
- U S TOWNSHIP LINE
- SECTION LINE
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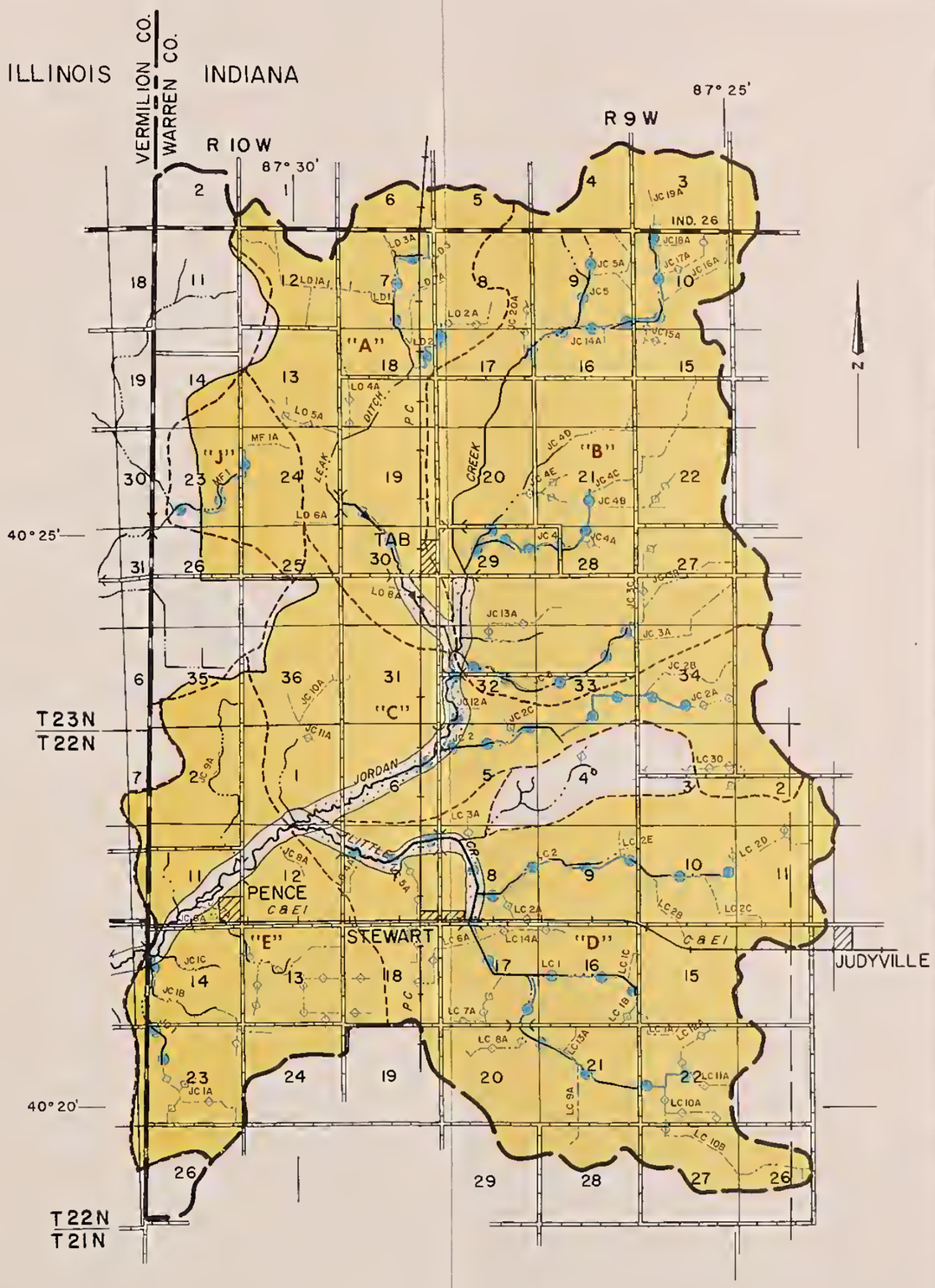
- CROSSING-ROAD UNDER
- BRIDGE
- PERENNIAL STREAM
- INTERMITTENT STREAM
- WATERSHED BOUNDARY

STRUCTURAL MEASURES

- GRASS WATERWAY WITHOUT TILE
- GRASS WATERWAY WITH TILE
- SURFACE DRAIN WITHOUT TILE
- SURFACE DRAIN WITH TILE
- OPEN CHANNEL

BENEFITED AREA

- FLOOD DAMAGE REDUCTION
- JOINT FLOOD DRAINAGE ENHANCEMENT
- REACH ("A")
- TRIBUTARIES (JC 4A)



SCALE 1/2 0 1 2 MILES

SCALE 1/101,000

SOURCE:
SCS BASE 5,P-21,843 AND, DATA
FURNISHED BY FIELD TECHNICIANS.
POLYCONIC PROJECTION

EXHIBIT 12

12-10-75
5,R-35,477